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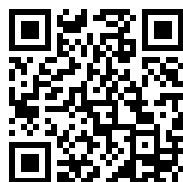
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# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

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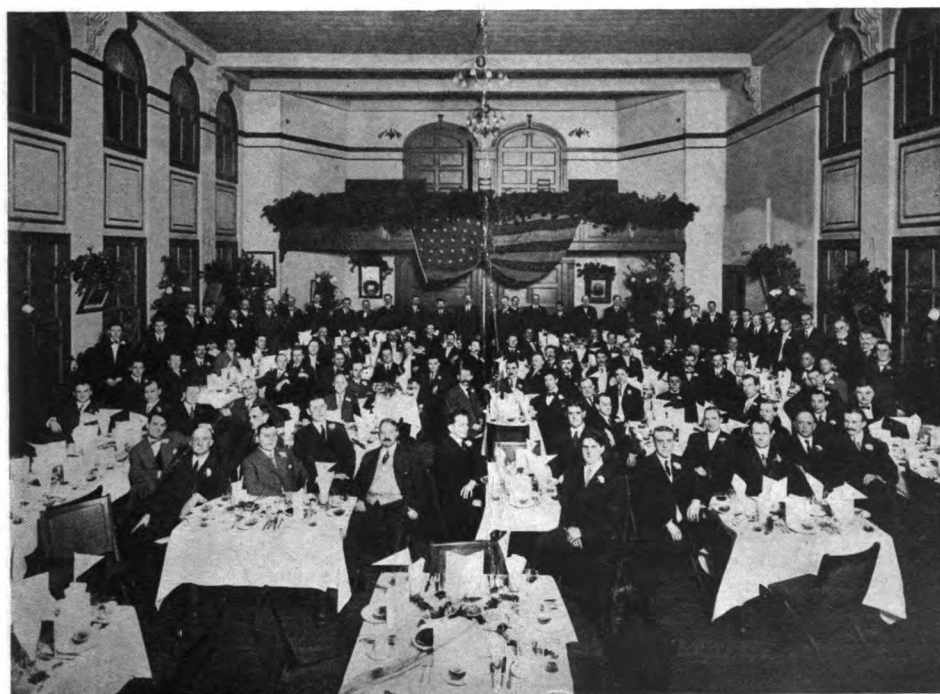
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1911

January

1911

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Dinner given to Travelling Representatives and Heads of Departments of Offices  
and Factories of Norton Company and Norton Grinding Company  
at the close of 1911 Sales Conference.

### NEW GRINDING DEVICES.

The recent issues of the trade papers illustrate and describe the following new grinding devices:

Automatic Cylindrical Sizing Grinder put on the market by Pratt & Whitney Co., Hartford, Conn., designed for medium size work. Machine uses a wheel 12" diameter with face from  $\frac{1}{2}$ " to  $1\frac{3}{4}$ ".

A machine designed for high grade internal grinding by the Garvin Machine Co., New York City.

A new large size Vertical Surface Grinder has been developed by Pratt & Whitney Co., Hartford, Conn. A cupped shape wheel 30" in diameter, with 4" rim and  $6\frac{1}{2}$ " high is used.

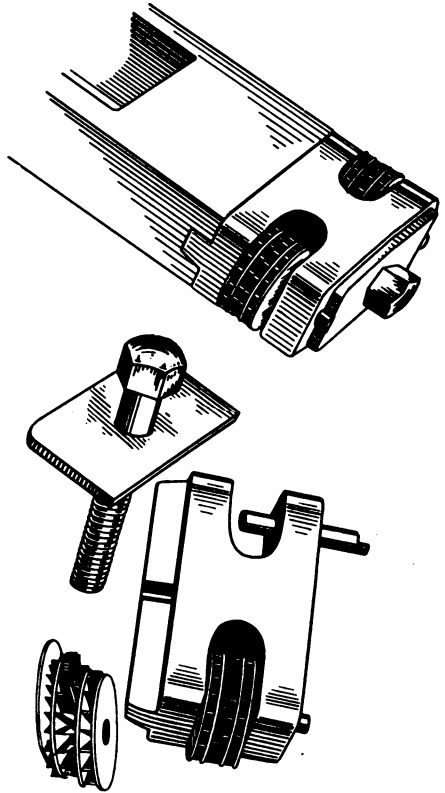
A 16" Internal Grinding Machine built by Churchill Machine Tool Co., Ltd., Manchester, England.

Pattern makers' disc grinder by The Gardner Machine Co., Beloit, Wis.

Chandler & Farquhar Co., Boston, Mass., are putting out two designs of skate holders known as No. 1 Federal and No. 2 Federal Skate Holder. The No. 1 can be used on any bench or floor grinder by adapting a plate to the grinder at such a height as will bring the skate nearly opposite the center of the wheel. The No. 2 was designed especially for hockey and racing skates without detaching from the shoes.

A portable pneumatic grinder and castings cleaner known as "Style A" by Cleveland Pneumatic Tool Co., Cleveland, Ohio. It will drive wheels up to 6" with  $1\frac{1}{4}$ " face.

A grinding or polishing machine with two independently driven spindles made by Osborn Mfg. Co., Cleveland, Ohio. It is adapted to the polishing and buffing of large work.



### THE NESBITT DOUBLE GRINDING WHEEL DRESSER

This tool was designed for dressing and truing wheels used on double disc grinders. Both wheels may be dressed at once making both surfaces parallel, and the dressing is done without raising the hood on the grinder.

All parts are made interchangeable.

The heads are made in two sizes: No. 1 head, for  $1\frac{1}{8}$ " cutters; No. 2 head, for  $1\frac{1}{2}$ " cutters.

### ALUNDUM FOR FLOOR TILES

A prominent architect of New York City evidently appreciates the durable quality of Alundum as he has placed an order for No. 36 grain to be used in making floor tiles in his own residence now being built.

## Modern Abrasives

By George N. Jeppson

*Part of paper read at the annual meeting of The Society of Automobile Engineers at New York City, January 11th and 12th, 1911. Balance of the article will be published in the next issue of "Grits and Grinds."*

The grinding wheel and the special machine for its use have reached a state of development where they are receiving appreciative attention in the mechanical world. The worker in metals recognizes that these tools have their useful field and the production engineer, in considering the proper method to be used in developing a finished machine part, must consider the grinder, would he compete with his progressive brother.

No industry has served more to bring before the world the utility of these tools than the one you represent, and I believe you will agree that the production of the automobile of to-day, with its ball and roller bearings, special alloy steels, and precision in all its essential rotating parts, would have been practically impossible without the grinding wheel and the machines on which it is used.

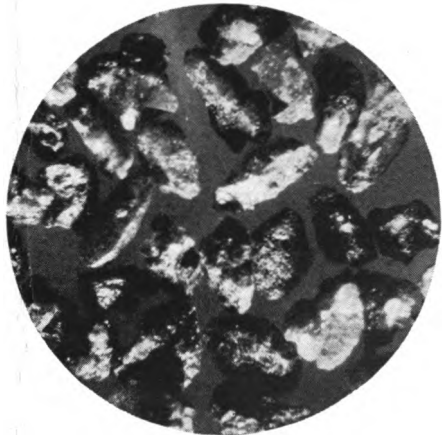
It was comparatively easy for the mechanical world to accept the artificial wheel of emery and corundum to take the place of the file on castings, and later to displace the grindstone in the sharpening of tools, and at about the same time, the earlier forms of surface and cylindrical grinding of hardened steel machine parts, for the obvious reason that the grinding wheel here had a clear field, and there were no recognized prejudices or habits to overcome. But as soon as we entered the field occupied by the lathe builder and the lathe hand, we had a campaign of education on our hands, which has, in the end, met with success.

The metallurgist has also in recent years created new fields for grinding, by the many new combinations of the elements with iron, giving us alloys which are difficult to machine in the old way. Those of manganese and iron can be machined only by grinding.

### ABRASIVES IN USE TO-DAY.

My contribution to-day will be on the grinding wheel. The essential parts of its structure are the bond and the abrasive. The abrasive, which forms the cutting teeth of the wheel, is graded into grain of standard sizes and the grain to be used is selected according to the duty it is to perform, and not only the size of grain must be considered, but also the temper or toughness, as well as the hardness. No abrasive in use to-day is the best on all materials. They each have their field, some because of their natural physical properties, and others because their composition allows them to be bonded better than others for certain classes of grinding.

In the following microphotographs, I will show the abrasives in use to-day and comment on them in detail.



NAXOS EMERY.

This abrasive is being rapidly replaced by the more efficient artificial abrasives. It has, however, still a use in those wheels used for certain grinding processes such as for steel balls. Wheels



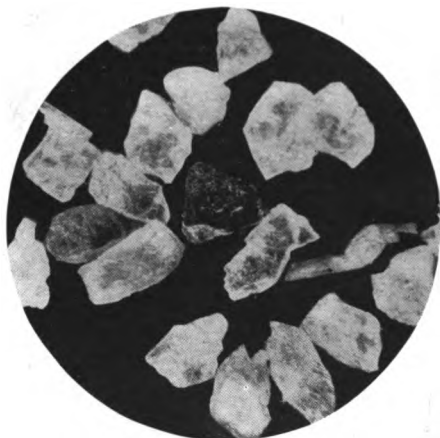
for this purpose must be bonded very hard, and the roughness of the surface of the grain and the high percentage of impurity allow this to be done with wheels made of emery. As an abrasive for general grinding purposes, it is not as efficient as the modern electric furnace product.

*Naxos Emery Analysis*

|                          |       |
|--------------------------|-------|
| Aluminum Oxide . . . . . | 67.13 |
| Ferric Oxide . . . . .   | 15.54 |
| Silica . . . . .         | 2.72  |
| Titanium Oxide . . . . . | 3.75  |
| Calcium Oxide . . . . .  | .43   |
| Magnetic Iron . . . . .  | 8.43  |
| Loss . . . . .           | 2.73  |

**CORUNDUM.**

This is a natural abrasive. Its quantity is limited and its quality lacks uniformity. Where the quality is good, it is an efficient abrasive on soft and heat treated steels.



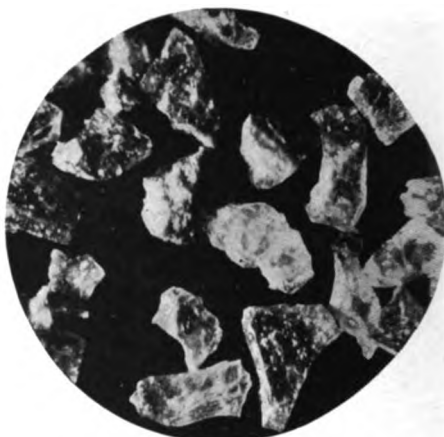
**CORUNDUM.**

*Corundum Analysis.*

|                          |       |
|--------------------------|-------|
| Aluminum Oxide . . . . . | 91.05 |
| Ferric Oxide . . . . .   | 3.45  |
| Silica . . . . .         | 3.00  |
| Titanium Oxide . . . . . | .25   |
| Calcium Oxide . . . . .  | .82   |
| Loss . . . . .           | 1.24  |

**ALUNDUM.**

This abrasive is made in the electric furnace, is produced from bauxite, a hy-



**REGULAR ALUNDUM.**

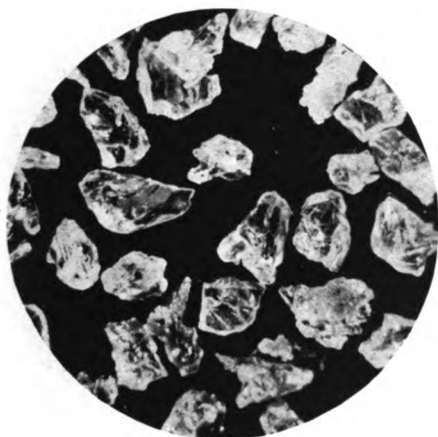
drate of alumina. Bauxite is purified in the electric furnace so that the product is high in crystalline aluminum oxide, and it is probably the most efficient abrasive known on steel. Its quality is under control and the quantity is unlimited. This naturally stands for duplication in wheels so far as this is practical and possible.

*Regular Alundum Analysis.*

|                          |       |
|--------------------------|-------|
| Aluminum Oxide . . . . . | 91.25 |
| Ferric Oxide . . . . .   | 2.50  |
| Silica . . . . .         | 1.75  |
| Titanium Oxide . . . . . | 4.35  |
| Calcium Oxide . . . . .  | .25   |
| Magnetic Iron . . . . .  | 1.25  |

**SPECIAL ALUNDUM.**

The greatest advance in recent years in the making of artificial abrasives is the art of being able to fix the toughness or what we call the "temper" of an abrasive. Very hard metals, like hardened tool steels, require for their efficient grinding an abrasive which is hard enough to penetrate the surface ground and tough enough to remove its chip without breaking off or dulling too quickly. If it breaks immediately, we are grinding on a lap without cutting points. The professional grinder says "grinding on the bond." If it is so tough that the cutting points just dull, you have increased the area of each tooth to such



SPECIAL ALUNDUM.

an extent that the friction in making the cut is so increased that we have heat and at the same time our depth of cut possible is decreased, and we have an inefficient wheel. The material shown in Fig. 4 is the most efficient material known for the grinding of all classes of special hard and tough steel.

*Special Alundum Analysis.*

|                          |       |
|--------------------------|-------|
| Aluminum Oxide . . . . . | 99.17 |
| Ferric Oxide . . . . .   | .65   |
| Magnetic Iron . . . . .  | .15   |
| Silica . . . . .         | .16   |

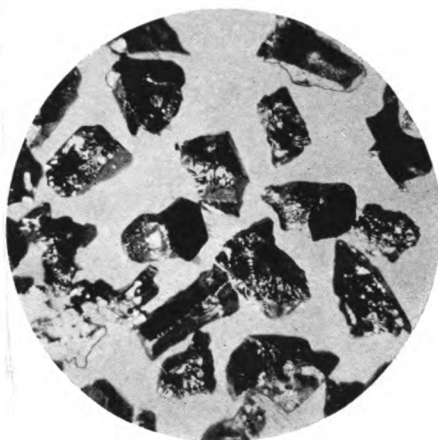
## CARBIDE OF SILICON.

Carbide of Silicon, otherwise known as Carborundum in this country, and in Europe under various other names, is an artificial abrasive made in the electric furnace from coke and sand, and is the hardest abrasive in use. It is the most efficient we have on cast iron, chilled iron and brass. In most cases it gives the desired finished surface, but where a high finish is desired the carbide of silicon wheel is used first in the roughing operation and the finish is put on with a wheel of an aluminous abrasive. In cylindrical grinding with wheels of carbide of silicon the main objection is in the wear of diamonds used in truing the wheel. I have a record of an Alundum and Carborundum wheel

where 25 cuts of 1-1000 each were taken with the same diamond on both wheels. Careful weighings showed that the ratio of wear was Alundum 1 to Carborundum  $4\frac{1}{2}$ .

*Carbide of Silicon Analysis.*

|                           |       |
|---------------------------|-------|
| Silicon . . . . .         | 67.50 |
| Combined Carbon . . . . . | 28.57 |
| Aluminum Oxide . . . . .  | .85   |
| Ferric Oxide . . . . .    | 2.06  |
| Silica . . . . .          | 1.08  |
| Titanium Oxide . . . . .  | .13   |
| Free Carbon . . . . .     | .44   |



CARBIDE OF SILICON.

The balance of this paper by Mr. Jeppson will be published in the next issue of "Grits and Grinds." It takes up the subject of bonds in modern grinding wheels and some experimental tests using wheels made of the different abrasive materials.

You are not expected to know everything about grains and grades of grinding wheels. That is the wheel manufacturers' business and the chances are strongly in favor of your getting some valuable suggestions, if you take up each grinding proposition with them.



Travelling Representatives of Norton Company and Norton Grinding Company who were present at this year's annual Norton Sales Conference.

### 1911 SALES CONFERENCE

In this year's annual conference of the Norton sales forces, Jan. 3rd to 6th, enthusiasm and co-operation were evident from the very beginning.

Interesting papers were read by a number of the salesmen touching on the troubles met by the grinding wheel and grinding machine salesmen, and many other topics of mutual interest to the sales and manufacturing departments. Illustrated talks were given on the following subjects: "Safety as Applied to Grinding Wheels," "Progress in the Manufacturing Plants," "Progress in our Abrasive Plants," "Refractories made of Alundum," "Rapid Turning Preparatory to Grinding."

As a fitting climax to the most successful annual conference of the Norton

companies, a dinner was given to the salesmen and heads of departments of offices and factories in Frohsinn Hall, Worcester, on Friday evening. The dinner was followed by two hours of real fun by the Norton Amusement Co. in a production full of local color entitled "A Gritty Grind."

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A young man writing from an automobile factory in the middle West, says:

"When this company received its first Norton Plain Grinder (a 14" x 72"), I was lucky enough to be assigned to operate it and received valuable instructions from your demonstrator. From that day I became very enthusiastic about grinding and this enthusiasm was also felt by my family as my pay increased."

## Grinding Points Gleaned from the Report of 1911 Sales Conference

If the spindle on which the wheel is to go is just a little smaller than the hole of the wheel, the wheel will be out of balance unless it is exactly centered which is a very difficult thing to do or have done in the average shop.

The color of a grinding wheel does not affect the cutting quality or the life. The cause of the differences in color in grinding wheels is the difference in color of the bond used in the mixture. Kiln conditions also affect the color to some extent.

On account of the large number of new and special grinding machines which are being put on the market, it is becoming more and more important that the grinding wheel manufacturers have the fullest and most complete information with their orders for wheels in order to execute them intelligently.

The use of compound in grinding improves the cutting and prolongs the life of the wheel.

It is not always necessary that grinding wheels should be trued with sharp diamonds. Sometimes unsuccessful efforts to obtain a good finish is due to the fact that the grinding wheel was trued with a sharp diamond. When truing, a square holder should not be used. A round holder enables the operator to present a new face of the diamond at any time. The new Norton holder has an arrangement whereby an additional twisting movement can be given to the diamond.

To get true grinding economy, we must have co-operation between the turning and grinding departments. Where modern manufacturing methods are in vogue, marked economy is shown in the turning department made possible by the use of modern grinding machines. Many times

the grinding machine is not given due credit for the saving in turning made possible only by the grinding methods.

No one should assume at the present day that because a grinding wheel is of fine grain, it will leave a fine surface on the ground piece or because a wheel is coarse it will leave a coarse surface. It has been shown that a fine wheel can make a fine surface and a coarse wheel can make a coarse surface; but it has never been shown that this must follow. In grinding chilled iron with an Alundum Wheel, for example, on rolls 10" diameter and 14' long we can make a mirror finish with a No. 10 wheel if we grind slow enough. If we should use a fine wheel on this work we would leave nothing but fine scratches.

It is known that scratches are caused many times by some of the material ground off the piece adhering to the wheel, whether or not the wheel is coarse or fine.

When there is no room for the chips, the grinding wheel loads, provided the wheel is strong enough so that the cutting grains do not break out.

I receive some complaints of wheels developing soft spots. In the majority of cases of this kind it is simply due to a soft wheel and is very easily overcome by substituting a harder wheel. (From salesman's paper.)

In most cases of complaints on wheels being out of true, I find that this is caused by the wheel having been forced on the arbor on the spindle and naturally with uneven side pressure. The hole is put out of line enough to cause the wheel to run out sideways even after tightening the nut. This is very easy to remedy, simply loosen and tighten the nut a few

times with a turning of the wheel thereby forcing the hole in line again. The cause of this may be due to the spindle being over-size although, of course, this is always denied by the customer. (From salesman's paper.)

If you have occasion to visit freight stations or storerooms where you see a great number of boxes, you will note that Norton boxes are the best and strongest looking of the entire lot. (From salesman's paper.)

As a rule the greatest economy is obtained by the combination of grinding with very rough turning. Yet there are cases where the least expensive way is to grind direct without turning.

A Norton Grinding Wheel used on a modern machine by an operator with a good knowledge of grinding is just as surely a milling cutter as if it were made of steel. Its cutting surface consists of millions of small sharp cutting teeth and each tool that comes in contact with the work cuts off a chip in the same manner as the tooth of a milling cutter.

You can appreciate, therefore, the importance of using wheels made of modern "grit" or cutting material. Grinding wheels made of different grit will give different results just as tools made of different steels will give different results.

By merely changing the speed of either the wheel or work, failure is sometimes turned into success. Even a slight variation in speed may make this difference.

If grinding wheel users would stop and consider that each particle or grain of abrasive is called upon to do more work as the grinding wheel is reduced in diameter he would not declare that the wheel is softer near the center because it wears faster.

Then, again, if he would see that the correct surface rate of speed is maintained as the wheel is reduced in diameter, the difference in wear would not be so noticeable.

Some of the things to be considered in selecting wheels are: the sizes of grains and the tensile strength of the bonding material necessary for the particular metal that is to be ground; the tensile strength or hardness necessary to withstand the vibrations brought about from mechanical defects in design of the machine on which the wheel is to be mounted; contact—whether broad, narrow, long or short—between the wheel and work; speed of wheel and work, and sometimes other conditions.

A great variety of combinations of grain and grade is required in surface grinding. Variation in sizes and shapes of pieces to be ground makes it necessary to vary the combinations of grain and grade of grinding wheels in order to get the best results.

### WASTES TIME OF MAN AND MACHINE

J. S. Sheafe, Engineer of Tests, Illinois Central R. R., Chicago, Ill., in an article entitled "Care and Selection of Shop Equipment" recently published in "Railway Age Gazette," has the following to say about the use of grinding wheels in railroad shops:

"Have Plenty of Grinding Wheels.—Grinding wheels, in most railway shops, are conspicuous by their absence from convenient locations. A machinist would rather continue for a while the use of a slightly dull tool than to bother going, perhaps, the length of the shop and waiting his turn at the wheel. This is hard on the machine, already hard pressed since the advent of high speed steel; also on the work and the man. When it is remembered that the rate of deterioration of a tool when dull does not vary as the work done, but as the square of the work done, there is an abuse all around. Grinding wheels should be placed in all parts of the shop, both machine side and pit side. This makes it inexcusable for a man to work with anything but perfect tools."

# GRITS AND GRINDS

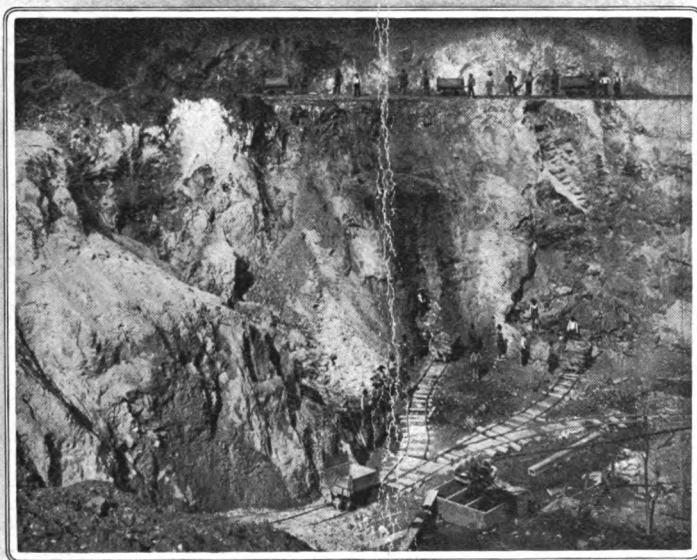
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1911

February

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**Bauxite Mine**

**Bauxite is the purest form of Aluminum Oxide found in nature.  
It is used in the manufacture of Alundum, the cutting material  
or grit used in making Norton Alundum Grinding Wheels.**

## Modern Abrasives

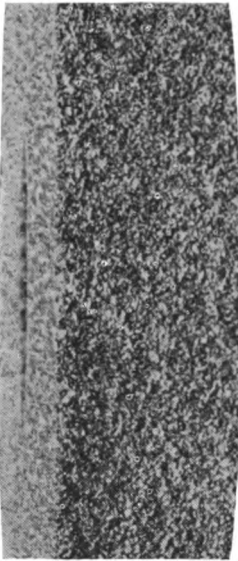
By George N. Jeppson

*Paper read at the annual meeting of The Society of Automobile Engineers.  
Continued from January Issue.*

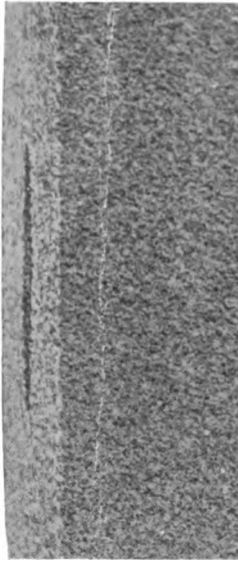
The function of the bond is not only to hold the cutting particles of the wheel together and to give the wheel the proper factor of safety at the speed it is to be run, but it must also be possible to vary its tensile strength to fit the work it is called upon to do. We often hear the operator

and weight of work, and many other like variables.

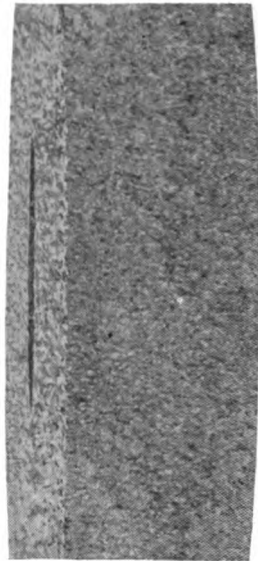
Wheels are bonded by what are known as the vitrified, silicate, elastic and rubber processes. Were I to enter into a detailed description of these bonds, it would require considerable time, and I will there-



VITRIFIED.



SILICATE.



ELASTIC.

say that the wheel is too hard or too soft. He means that the bond retains the cutting teeth so long that they become dulled, and this wheel is inefficient; or, in the case of a soft wheel, the bond has not been strong enough to hold the cutting teeth and they are pulled out of the wheel before they have done the work expected.

The bond to be used for a given operation depends on the wheel and workspeeds, area of wheel in contact with the work, vibration in wheel spindle or work, shape

and weight of work, and many other like variables.

No one bond makes a superior wheel for all purposes; each one has its field.

### *Vitrified Bond.*

This bond is made of fused clays, is unchanged by heat or cold, and can be made in a greater range of hardness than any other bond. It does not completely fill the voids between the grains, and therefore, a wheel bonded in this way having

more clearance than any other, is adaptable for all kinds of grinding except where the wheel is not thick enough to withstand side pressure. This bond has no elasticity.

#### *Silicate Bond.*

This bond is composed of clays fluxed by silicate of soda at low temperatures. It is not as stable as the vitrified bond as regards dampness, gives less clearance between grains, and has a range of hardness below that of the vitrified in the harder grades. This bond has no elasticity and will not make a safe wheel of extreme thinness.

#### *Elastic Bond.*

This bond is composed of shellac and other gums. It completely fills the voids of the wheel, has a limited range of grades, has a high tensile strength and elasticity, and can be used for the making of very thin wheels. The rubber or vulcanite bond has the general characteristics of the elastic, but its grades of hardness cannot be varied to the same extent and its uses are limited.

#### *Proper Combined Abrasive and Bond.*

From what I have said about abrasives and bonds you have probably come to the conclusion that given a certain grinding operation you must, in order to have the most efficient wheel, have a combination of right abrasive and proper bond. In order to show conclusively that the abrasive of which crystalline aluminum oxide is the cutting property, such as emery, corundum and Alundum, is superior to carbide of silicon on metals of high tensile strength, such as alloy steels, high and low carbon steel and wrought iron, and also to show that carbide of silicon is superior on metals of low tensile strength, such as cast and chilled iron, the following tests have been made:

#### *Testing Apparatus.*

The apparatus used was a motor-driven Norton Cylindrical Grinding Machine, of the 14 x 72 size, equipped with ball bearing spindle, tachometers for recording revolutions per minute of the work

and wheel spindle, the electrical energy used being registered on a Westinghouse graphic ammeter. The efficiency of the abrasive wheel we considered to be measured by the horse-power required to do a given operation. All conditions of the tests were constant, except the abrasive wheel. The test piece was of 25-point machinery steel, 2 inches in diameter and 24 inches long. The abrasive wheels were the best we had available for the purpose.

The following curves were developed from these tests:

#### *Curve Sheet No. 1.*

An analysis of the curves shows that Alundum is the most efficient abrasive for this work. It is easy to explain the efficiency of Alundum as compared to emery. Both abrasives are of the same nature chemically, the only difference being that Alundum is of greater purity. It is known that the higher the percentage of crystalline aluminum oxide the more efficient is this type of abrasive. Why carbide of silicon, which is harder than emery, corundum or Alundum, should be less efficient on steel than even emery is not so easy for the layman to understand. The reason is that carbide of silicon lacks the property of toughness. By test, as compared to Alundum, it is in the ratio of 1 to 4. This means that in the grinding of steel, a metal one of whose properties is high tensile strength, the cutting tooth is broken off close to the bond and we are then grinding on a cutting surface composed to a large extent of bond. The wheel, having neither cutting teeth nor clearance, quickly glazes. Some who have used this material on high carbon steel and got a highly burnished, bluish surface at the expense of time and horse-power may correctly assume that they were grinding on a lap consisting of carbide of silicon and porcelain bond.

Before we leave this curve I would call your attention to the rapid rise in horse-power in the carbide of silicon and emery wheel. In the carbide of silicon this is due to the fact that the brittle tops



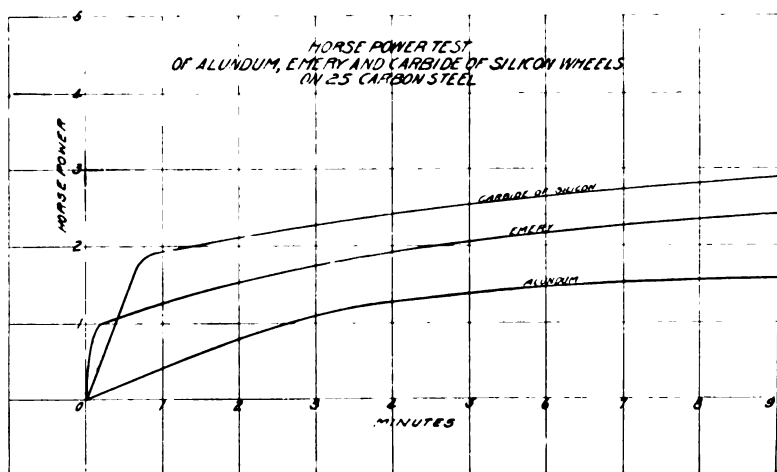


FIG. 1.

of the cutting teeth are immediately wiped off, leaving the duller wheel, with consequently greater consumption of horse-power. The emery wheel, being composed of a softer material, also loses its cutting teeth, but being tough, not to the extent that you get down to the bond as quickly as in the case of the carbide of silicon wheel. The Alundum wheel shows a more consistent curve, this material having the properties of toughness and hardness so combined as to make it of the highest efficiency on metals of this class.

#### *Curve Sheet No. 2.*

This chart shows the relative efficiency of Alundum and carbide of silicon on cast-iron. You will note that here the Alundum wheel is superior to the carbide of silicon up to the fourth period, but after passing this point the carbide of silicon becomes more efficient, the reason being that the grain is tough enough to withstand the light work it has to do in cutting metals of low tensile strength. Its hardness also serves to keep its cutting teeth sharp.

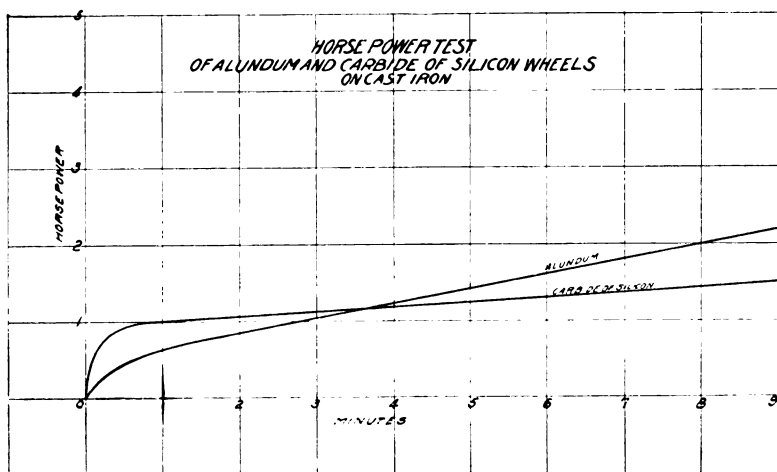


FIG. 2.

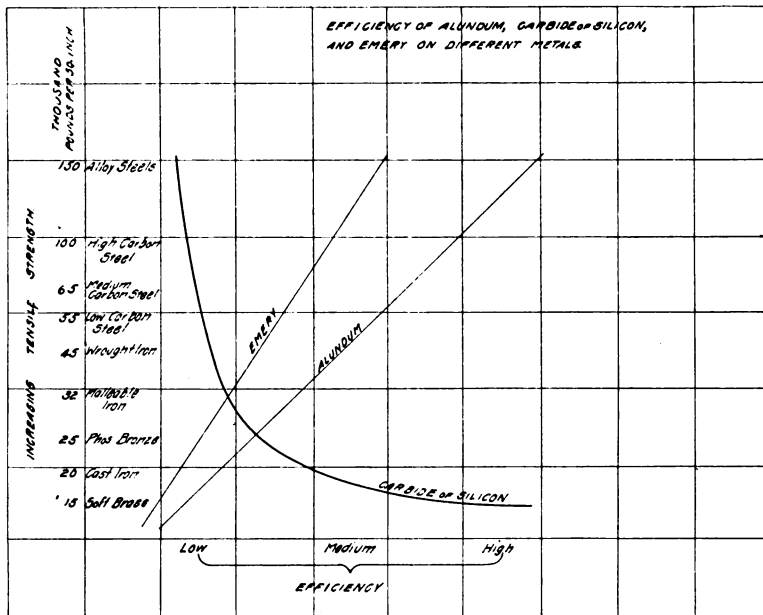


FIG. 3.

*Curve Sheet No. 3.*

This chart shows the relative efficiency of the abrasives in question, and may be of assistance in determining the kind of abrasives to be used.

In conclusion, I believe that with the

general interest which is now being shown in the grinding wheel and machine, and the fact that the wheel is becoming recognized as a cutting tool rather than a grindstone, rapid advances will be made in the near future in the art of grinding.

## He Uses the Norton

*Norton Company:*

The following ensued in the filing room of the ————Lumber Co. of——— between an elderly saw filer and an apparently new mill supply man:

"I perceive, sir," said the mill man, "that you are using Norton Grinding Wheels."

"Yep," answered the saw filer, "I've used those wheels for many years and there are none better!" "Then," added the mill man, "you wouldn't consider any other wheel on the market; nothing could induce you to change wheels?"

"No sir ee, let me tell you, young feller, that I've used them wheels of Norton's for a long time and I have n't seen their equal for any use!"

"We are," said the M. S. man—

"Now you can't sell me any other wheel at all," interrupted the elderly gent.

"As I was trying to say, we—"

"No use, to talk wheels to me," insisted the filer.

"Well," hollered the mill supply man, "We carry a large number of Norton wheels and are one of their agents, and would sell no other make and if you were not so belligerent, I would have saved a lot of your wind so you could use it in telling me the quantity and sizes of the wheels you are going to buy from me, now."

Needless to mention, an order followed.

JENNISON HDWE. CO. Protege.

## Experiences in Demonstrating Norton Grinders in Europe

*Excerpts from paper by Mr. H. Darbyshire read at Norton Company's 1911 Sales Conference.*

Grinding in Europe has been perhaps as varied as may be found on this side and the rate of production bears some relation in many instances. To quote a few instances:

Pressed steel Shrapnel shells, 3" dia. by 8" long are being ground at the rate of 25 per hour removing .040",—this at one private and one State factory in Germany.

In the automobile trade in France, 20 pistons 3" x 3" were ground per hour. 80 valve stems per hour have been ground and 60 per hour is the average output of a 6 x 32" Norton machine in England. Not so much has been done with crankshafts, but some English firms are giving preference to Norton machines for this purpose and have discarded competitive machines.

One English firm is using 28 Norton machines for work in the automobile trade.

Car axles is a line which has opened a fairly good market for grinding machines in middle Europe owing to the demand for a ground surface finish on the part of Government railway inspectors. One firm is grinding 1,000 axles a month with two 18 x 96" machines, day and night shift.

The average time for a car axle in mid-Europe is about 40 minutes on a day's run. On my last visit to ——— Works, the operator of a Norton 18 x 96" machine was grinding locomotive axles with 9" journals in 28 minutes per axle. Almost every German state railway repair shop uses a Norton machine for cleaning up piston rods.

The principal machine tool shops in Germany are equipped with Norton machines. At one electric works a tramway motor shaft formerly cost 78c. for turning and 35c. for grinding; a total of \$1.13. This has now been re-

duced to 25c. for turning and 18c. for grinding, or a total of 43c.

One interesting job was the grinding of black steel bars 10 ft. long on an 18 x 120" machine. These had to be parallel within .002" and had .080" to remove from diameter. Cost of labor for grinding was 70c., time being 50 minutes to one hour each.

The grinding of barrels for the Mauser rifle is carried out extensively in Berlin in a private factory and in State factories at Erfurt and Dantzic. A 10 x 50" machine is used for each operation—that is, there are three separate diameters on the barrel each one being a taper from the muzzle upwards. The barrels are held by a rigid steady rest at a spot which is true with the bore. This steady rest is in the form of two half-round shoes which open in scissors fashion and grip the barrel firmly, one side being open to allow wheel to pass and clean up the spot a few one thousandths. At the Berlin factory, the time taken per section of barrel was about one minute for each taper section, or a total of about four minutes per barrel.

Transferring a wheel after worn down to a small diameter, from a large machine to a small one, is a good plan.

A variety of grades of wheels can be profitably employed when the amount of grinding will warrant it.

Considerable difference in diameters of work will affect the cutting of a wheel on any given material.

A successful wheel on the smaller diameters may work much slower on the larger.

A wheel most suitable on work of very large diameter may wear away too fast on work of smaller diameter.

## Practical Use of Abrasive Wheels in Foundries

By R. G. Williams

The following letter was addressed to the "Iron Trade Review," in reference to certain statements made in a paper read before the Pittsburgh Foundrymen's Association, and printed in the above publication.

The original paper, among other things, took up the subject of safety collars, under which heading the use of tapered safety collars is recommended in preference to the protection hood.

Mr. Williams, in his letter, gives good reasons why the protection hood should be used wherever possible regardless of what kind of flanges are used.

"While agreeing in part with the article on "The Practical Use of Abrasive Wheels in Foundries," in the October 20th, 1910, issue of the Iron Trade Review, there are several points which we cannot concede.

"We have found it advisable to use protection hoods wherever possible, irrespective of the type of flanges or collars in use. These hoods should be very substantial. The article states that it is only necessary to use protection hoods where straight sided wheels are used, and also conveys the impression that grinding wheel accidents are only caused by wheels bursting. If grinding wheel accidents were only due to wheels not being strong enough to withstand the centrifugal force which is present at efficient speed, safety collars would give the desired protection. However, a list of grinding wheel accidents will show a very low percentage of wheels breaking from inherent weakness.

"Prof. Benjamin, of the Case School of Applied Science, has probably made more investigations on the breaking of grinding wheels than any other person in this country, and is the authority for this statement: 'The common cause

of grinding wheel failure is in allowing a small piece of work to slip or roll between the wheel and the rest.' If protection hoods are in use, the operator is safe. If protection hoods are not in use, the operator is in danger, since, no matter what type of flanges are used, fragments break off the wheel outside the flanges.

"Another impression given by the article is that safety collars furnish a grinding wheel with inherent strength. Just as soon as centrifugal force becomes greater than the tensile strength of the wheel, the wheel will break, no matter what kind of flanges are used.

"The article further overlooks the fact that there are many wrong ways of mounting straight sided wheels, all of which greatly increase the chances for accident. There is only one right way.

The flanges should be relieved, that is, countersunk so that they bear only near the outer edge on a flat ring surface which is approximately one-eighth the diameter of the flange. Compressible washers of pulp or rubber slightly larger than the flanges should be used between the wheel and the flanges. Care should be taken in mounting to have the spindle and hole in the wheel bear such relation that the wheel slides on easily but not loose enough to permit of any play. The inner flange must be keyed or pressed on the spindle, never, loose, as it would be liable to drag on the boxes and cause the nut to crawl. This would exert a crushing force on the wheel, causing it to break easily. No great pressure is required to hold the wheel. The nut should be tight enough to hold the wheel firmly, but avoid unnecessary pressure between the wheel and flanges. Rests should be adjusted so that there is no possibility of the work becoming caught between the wheel and the rest.

"Conservation of human life is finally receiving the official recognition it demands. State legislators in this country and governmental commission in Germany and France have drawn up laws pertaining to the use of grinding wheels. The first and foremost requirement is that every grinding machine shall be equipped with a substantial protection hood, irrespective of the type of flanges or collars in use. Long years of experience has shown that the straight sided wheel, mounted between relieved flanges half the diameter of the wheel, and covered by a substantial protection hood possesses the maximum of good qualities. Use safety collars if they add to the feeling of security, but insure against accident by the use of protection hoods."

R. G. WILLIAMS,  
NORTON COMPANY  
Dept. of Tests.

### CRANKSHAFT GRINDING

*Excerpts from Paper by Oscar Knight,  
Demonstrator for Norton Grinding Co.*

It has been my experience, during the past year, that a crankshaft of 30 to 40 carbon, not heat treated, requires on the average one-third less time to rough grind than one that has been so treated.

The finish grinding of either heat treated or non-heat treated shafts consumes the same amount of time, but the wheel for the heat treated shaft requires dressing oftener than for the other.

The Norton 24 Combination, grade N, is best for roughing and the 24-M for finishing. Up to the present, I know of no better grade and grain wheels, unless the steel is very hard when a 24-M is good for roughing and, sometimes, even an L is needed, but these cases are rare and occur only in the very highest priced shafts.

"A man is known by the company he keeps" and a crankshaft is known by the wheel used on it. When you hear of so-and-so having great success with an O or a P on crankshaft grinding, just you

refuse to ride more than ten miles an hour sitting right over one of those same shafts.

One of the troubles you will find on crankshafts is chatter marks. These may be caused by the following conditions: The grinding wheel may be worn down so as to be out of balance.

The sides of the wheel may be out of true.

The work shoe may be worn larger than the finish diameter of the work.

The work may be revolving too fast.

The wheel may need truing.

The wheel may be too hard.

In order to obtain work that is round, straight and also within the limits, requires a certain amount of skill on the part of the operator. There are certain things in the grinding of crankshafts that cannot be explained. These things are what help one operator to produce more work per day than another, and, in order to be able to produce a satisfactory output, a man must learn what these unexplainable things are. In order to become a "grinder man," he must learn:

How to operate his machine.

How to true his wheels in different ways in order to obtain a desired surface.

He must learn the difference between good and bad work, and work that is good enough for the purpose.

He must insist on large, round center holes.

He must use plenty of water.

And, above all else, he must learn to have his common sense on the job all the time.

When buying lathe tools the important question is "kind of steel." With grinding wheels (also metal cutting tools), it is "kind of grit." Norton Grinding Wheels are made of the right "grit."

A hard wheel is more apt to change the temperature of the work or to become glazed than a soft one; furthermore, it requires more power to do the same amount of work.







# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

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1911

April

1911

# Crystolon

## Norton Crystolon Grinding Wheels

- Q. CRYSTOLON is the registered trade name for Norton Carbide of Silicon (SiC).
- Q. With this material, in addition to the different kinds of Alundum, the Norton Company are in a position to satisfy every requirement of the trade and to offer to the users of Grinding Wheels, or Abrasives in any form, a choice of the latest and best cutting materials.
- Q. CRYSTOLON is manufactured by Norton Company in their Electric Furnace Plant at Chippawa, Canada.
- Q. The current for operating the Crystolon Furnaces, as well as those for the manufacture of Alundum at Niagara Falls, N. Y., is furnished by the Hydraulic Power Plants of Niagara.



## New Norton Products

### "CRYSTOLON"

Crystolon crystals, four tons of them each day, are being produced by our new electric furnace plant at Chippawa, Canada, which was completed about six months ago, and is now in full operation.

It has always been the aim of the Norton Co. to keep up to date in development of new abrasives for all kinds of work. With Alundum in its different qualities, we have been extremely successful in grinding all forms of steel. But realizing that a product of peculiar qualities was necessary for success in grinding metals of low tensile strength such as cast iron and brass, we have built this new furnace plant for production of carbide of silicon, which will be sold under the registered trade name of Crystolon.

With every crystal sparkling like a diamond, and radiating all the colors of a rainbow, this hard, quick-cutting abrasive is shipped from Canada to Worcester in bulk, and here treated in a way to render it suitable for the manufacture of grinding wheels and sharpening stones as well as for sale in the grain.

Crystolon, although one of the newer Norton products, has already taken its grip, and is tightening it every day. Like all other Norton products, its introduction was on a conservative basis, and success followed our trials. This achievement was gratifying to us, and will be to all who use and sell Norton products.

Crystolon is being manufactured in a brand new plant. It has the advantage of all the newest machinery and equipment known to modern science, to assist in its production and refinement. Under its new form of manufacture, it cannot help but prove far superior to any product of its kind hitherto marketed.

In view of the quick success of Crystolon and the fast increasing success promised by each new trial, word is given to our entire sales force to push this product for the especial uses for which it is peculiarly adapted.

With the acquisition of Crystolon to Alundum, we now have a complete line

of artificial abrasives for every possible grinding or polishing operation. Combine these abrasives with Norton thoroughness and skill in bonding, and the finished product stands for the highest degree of grinding efficiency.

### NORTON ALUNDUM REFRACTORIES

Attention has been drawn once more toward the Norton Co., in its march of progress, because of the recent launching of its new line of refractories, known as Norton Alundum Refractories.

Already there have been numerous mail inquiries from scientists, chemists and others who have used them. There has also been much favorable comment concerning the many purposes for which the new Norton Refractories may serve because of their peculiar virtues.

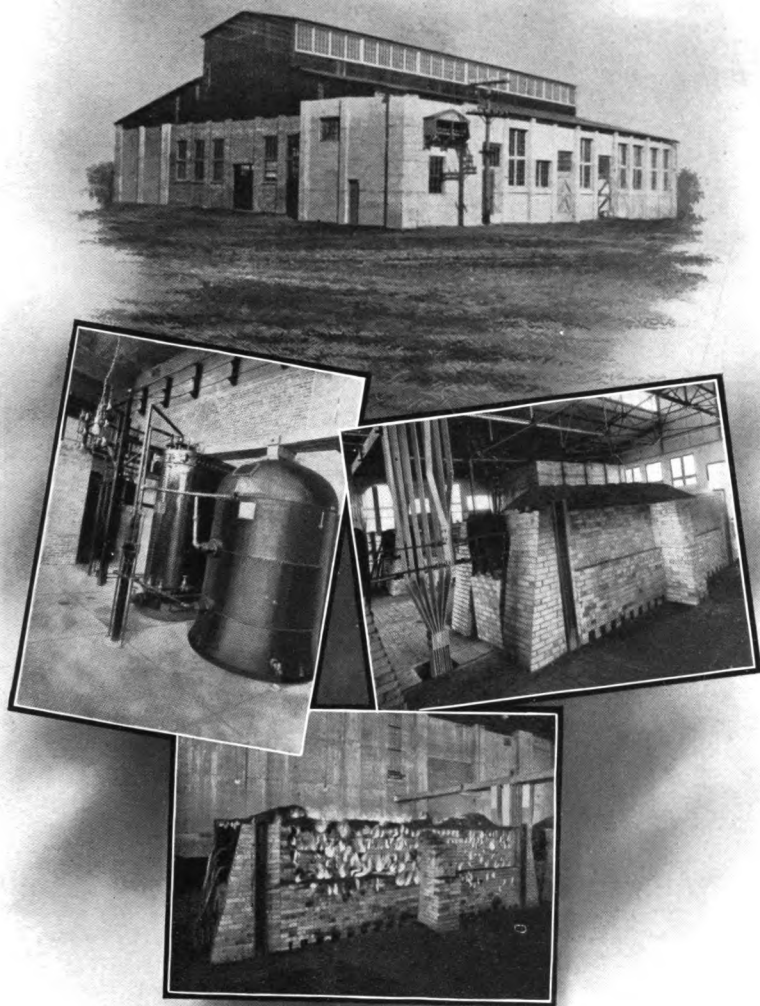
The exploitation of these refractories was one of the principal features of the meeting of the American Electrochemical Society in New York, April 6th to 8th inclusive, and much interest was shown.

At the meeting Mr. L. E. Saunders, chemical engineer of the Niagara Falls and Chippawa, Canada plants, read a paper on: "Electrically Fused Alumina-Alundum—as a Refractory," which appears in another section of this issue.

The experimental stage in manufacturing these refractories with tests and trials, all recent ones of which have met with success, has covered a period of three years, during which time, every small detail was worked out in the Norton Co. laboratories, and Norton Alundum Refractories were brought to a stage of perfection, which is gratifying to those who have worked with them so long for success.

As the refractory utensils are illustrated and described on other pages of this issue of Grits and Grinds, we will not go into descriptive paragraphs at this time.

Norton Alundum Refractories are one of the products of the Norton policy of thoroughness and study, and like all other Norton creations, will take the lead in their peculiar sphere.



**Plant for the Manufacture of Crystolon at Chippawa, Ontario, Canada**

**Electric Transformer**

**A Crystolon Furnace Ready for the Current**

**A Crystolon Furnace Burning**

# Crystolon

## The New Norton Carbide of Silicon

Crystolon is the registered trade name for Norton carbide of silicon which has the composition SiC.

The raw materials used in its manufacture are coke, sand, salt and sawdust which are carefully and accurately mixed, and heated in the furnaces to a temperature of between 1,820 and 2,250 degrees Centigrade. Each charge in the electric furnace consumes about 1,000 H. P.

The illustrations on page 3 are views of Norton Company's electric furnace plant for the manufacture of Crystolon at Chippawa, Canada. The current for operating the furnaces is furnished by the hydraulic power plants of Niagara. A Crystolon furnace set up ready to turn on the current is shown. The arrangement of the furnace, its electrical connections, its size, shape and design are all in accordance with the most advanced ideas of electrical and electric furnace construction.

The electric apparatus for transforming and regulating the current consists of 750 KW General Electric transformer with an induction regulator connected with it. This gives a range of voltage from 75 to 215. The primary current is 13,000 volts and the secondary voltage can be varied at the will of the operator so that a perfectly uniform voltage is secured.

The skill with which the furnaces are set up and the care used in making the mixture are important factors in the successful production of carbide of silicon. Under the supervision of Mr. F. A. J. Fitzgerald, a pioneer in the manufacture of carbide of silicon and a chemical engineer of international reputation, and by the use of the purest materials, and a process that is scientifically correct in every respect, the Norton Company are

producing a cutting material of wonderful purity and remarkable cutting qualities.

A full line of Norton Crystolon Grinding Wheels and Norton Crystolon Sharpening Stones are now manufactured by the Norton Company. With this cutting material, which possesses certain characteristic properties that make it particularly valuable for work on certain kinds of metals—especially the softer metals—in addition to Alundum, it places the Norton Company in a position to give the user of these materials the wheel or stone best adapted to the work and conditions.

Norton Crystolon Grinding Wheels are made in the same variety of sizes, shape and combinations of grain and grade as the well known Norton Alundum Wheels.

Crystolon Grinding Wheels will be marketed by the Norton Company direct in the same manner as the Norton Alundum Wheels, and the Norton Crystolon Sharpening Stones will be marketed by the Pike Manufacturing Co., Pike, N. H., who for several years have been the exclusive selling agents for the Norton line of India Oil Stones.

### NEW GRINDING DEVICES

The recent issues of the trade papers, illustrate and describe the following new grinding devices:

Cylinder Grinding Machine by Brown & Sharpe Mfg. Company, Providence, R. I.

Universal Grinding Machine by Morse Twist Drill & Machine Company, New Bedford, Mass. It takes wheels 12" in diameter,  $\frac{3}{8}$ " to  $\frac{3}{4}$ " thick, and 7" diameter with thickness of  $\frac{3}{8}$ ".

A new type of Grinder made by North Wales Machine Co., Inc., North Wales, Pa. It carries two grinding wheels, maximum diameter of wheels 8"; thickness, 1"; hole,  $\frac{3}{4}$ ".

## Norton Alundum Refractories

While the valuable cutting properties of Alundum, which make it a superior grit for use in the manufacture of Grinding Wheels and Oil Stones, have long been appreciated by users of these products, it is only recently that other properties of Alundum—such as high melting point, high thermal conductivity, chemical inactivity, low coefficient of expansion, etc., have been recognized by the chemical laboratory in the development of high temperature work.

Experiments during the past few years have demonstrated that Alundum is especially adapted to the manufacture of

small electric furnace parts such as cores, muffles, tubes, etc., for either wire wound or carbon resistance furnaces.

The valuable properties of Alundum for the manufacture of electric furnace parts are high thermal conductivity and chemical inactivity.

Alundum Refractories for high temperature work such as crucibles, combustion boats, and also filtering dishes, extraction thimbles, are now on the market.

The illustrations on the following pages will give an idea of the possibilities in this line by the use of Alundum in connection with electric furnace parts.

### “Electrically Fused Alumina—Alundum—As a Refractory”

*Paper read at the Recent Meeting of American Electrochemical Society by Mr. L. E. Saunders. While this paper is of a technical nature and may not be clear to all of our readers, those interested in laboratory work will find it interesting and valuable.—Ed.*

In the earliest endeavor to preserve primitive fire, it became necessary for its users to have a container for that precious element. It is therefore probable that the first experimental work ever undertaken on refractories was the search of our prehistoric ancestors for an earth or rock which best conserved and protected the meagre and valuable flame.

The term refractory has, since then, taken on a wider and wider significance as the demands on refractory bodies have increased. The meaning now attached to the word varies almost with the user of it and with the use to which the body is to be put.

There are some common properties, desirable in all refractories, however, such as high melting point, mechanical strength

at high temperatures, low coefficient of expansion and resistance to abrasive action. These are well recognized as refractory essentials or at least desiderata, and I will not further discuss them at this time or more than mention now other properties such as thermal and electrical conductivity and resistance to chemical action, which are desirable or essential only in especial cases. I would now only call attention to the fact that it is but rarely that the material selected fulfills all the requirements and it is usual to choose a kind having the least of the ills that refractory materials are heir to.

The substance I wish to bring to your attention to-day is electrically fused Alumina, bearing the trade name of ALUNDUM. It was primarily developed for abrasive purposes, but its heat-resisting properties were so often urged that it led to its introduction into this field.

There are two forms of ALUNDUM of interest to us here. First, a white crystalline product, having less than one per cent. of impurities, and second, a

reddish brown vitreous material having from six to eight per cent. of impurities; these consisting in both cases of oxides of iron, titanium and silicon. They are both electric furnace products from the mineral Bauxite, having undergone different degrees of purification. The purer white product has a melting point between  $2,050^{\circ}$  and  $2,100^{\circ}$  Centigrade; the brown product not more than  $50^{\circ}$  lower. The coefficient of expansion is linear and is, for the white product .0000078 and the brown material .0000085. The thermal conductivity is about twice that of Marquart porcelain and three to four times that of most fire clay. The hardness in

of a refractory and ceramic nature, moulding the desired pieces after the manner of the potter and burning them in a ceramic kiln. The resulting articles are more refractory than the binding agents employed, an exception to the old rule that a chain is no stronger than its weakest link. The amount of bond is varied in different forms, but in none of these articles does the melting point drop below  $1950^{\circ}$  Centigrade. Other properties have changed but slightly. For instance, the temperature coefficient is, in the more refractory bonded bodies, .0000059. The thermal conductivity is still twice that of Marquart porcelain. The strength,



### Electric Furnace Parts

Mohr's scale is above nine, but lower than ten. Both kinds of products are quite unattacked by aqueous acids and alkalis and very superficially by fused alkali carbonates. Basic or acid slags dissolve it with some difficulty, acid slags having a readier action.

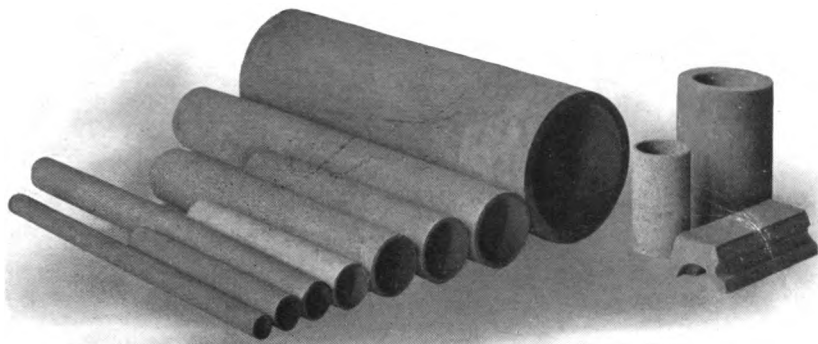
Some attempts at moulding it from the liquid condition have met with partial success, although the difficulties involved are so great that only very simple and crude forms have been made.

The method of application which has been found easiest and of which most of these specimens are examples, consists in mingling the crushed grains (the purer form is mostly used) with a binding agent

both tensile and compressive, is very high even at high temperatures.

The charge of electrical resistance with temperature as determined by Dr. M. deKay Thompson is as follows: at  $535^{\circ}$  degrees C.,  $476 \times 10^6$  ohms; at  $721^{\circ}$  degrees C.,  $49 \times 10^6$  ohms; at  $908^{\circ}$  degrees C.,  $24 \times 10^6$  ohms; at  $1040^{\circ}$  degrees C.,  $7.5 \times 10^6$  ohms.

The muffles shown here are distinguished by high thermal conductivity and high melting point. They have four to five times the life of the ordinary clay muffle in gas furnace work. They are especially adapted to the electrically heated wire wound type of laboratory furnace. They have the advantage over quartz of being



### Alundum Tubes for High Temperature Electric Furnace Work

more refractory and of higher tensile strength. They are porous and cannot be used where entirely gas tight furnaces are required.

The tubes are similar to the muffles and have found chief use along the same lines. They are also porous and cannot be used for pyrometer protection tubes.

The crucibles are made of varying density, but are still porous in all cases. This prevents their use in fusing slags or salts; but metals, even platinum, may be melted without injury to the crucible. This seeming disadvantage of excessive porosity has been turned to good account in the laboratory sizes. They answer all purposes of a Gooch filtering crucible without the trouble of preparing the asbestos blanket, and the porosity can be so controlled that the most finely divided substances may be cleanly filtered. The usual analytical precipitates are quickly and surely separated and may be ignited quickly in the crucible on account of its high heat conductivity. Even deflocculated graphite may be separated from its suspending medium.

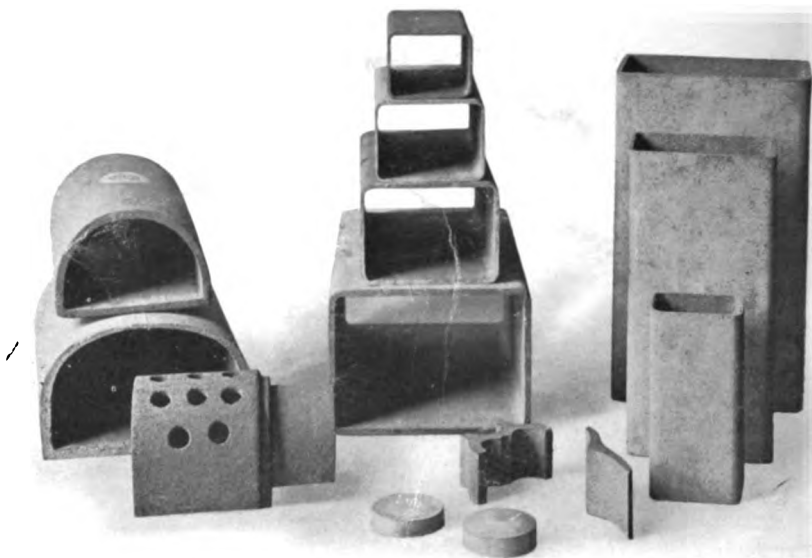
Large filtering dishes are also made and have been found useful in making organic

preparations and in bacteriological work. An extraction thimble for the Soxhlet or similar apparatus is very useful as it may be cleaned simply by ignition over a burner and used repeatedly.

Combustion boats of various sizes are valuable on account of the inherent properties of the product. If it is desired to use a boat of some other material, some carefully prepared ALUNDUM grain free from carbon sprinkled over the bottom prevents the sample from sticking in an oxygen combustion.

A useful modification is ALUNDUM cement which may be used to coat the inside of crucibles and furnaces for high temperature work. It does not melt or combine with carbon below 1,950° Centigrade and may be used for lining larger sized crucibles than it has seemed practicable to make entirely of ALUNDUM.

Enough of these articles have been described to show that there is a wide field of application, and that it is possible to produce almost any shape that may be desired. Indeed the greatest difficulty so far encountered is that each user desires a different shape or size so that it



**Alundum Muffles**

has been impossible to make many stock articles.

It will be noticed that mostly all of the forms shown here are of laboratory or semi-commercial types. Little mention has been made of the larger commercial uses. By the very nature of the process of manufacture, such a substance is costly and in excuse for the early development of the small articles rather than more commercial forms it may be said that the cost of the material entering into their composition is relatively small, while in the case of bricks it is relatively great.

Some work has been done, however, on testing out ALUNDUM bricks. A Heroult furnace in the experimental department of our Niagara plant was equipped with a roof of these bricks in April last year. Since that time the furnace has been used at intervals totaling about three months actual running time with some forty or fifty shut-downs and the roof is still in usable condition. It may be added that the temperatures used are decidedly higher than in the steel furnaces, so high in fact that a regulation Silica roof previously tried went down in five or six hours.

Until this and other trials are complete no claims will be made for ALUNDUM brick. It may be said at the outset that they cannot economically be used in contact with slags, either acid or basic. Nor can they be usefully employed where the present refractory life is very long. It is desirable to leave further reference to them for a later communication to the Society should the completed data have a favorable aspect.

In this outline it is thought that enough has been said to indicate that this new product may be of some assistance in the development of high temperature work.

All works must have a price in proportion to the skill, taste, time, expense, and risk attending their manufacture. Those things called dear, are, when justly estimated, the cheapest; they are attended with much less profit to the maker than those which everybody calls cheap. . . . A composition for cheapness, and not for excellence of workmanship, is the most frequent and certain cause of the rapid decay and entire destruction of arts and manufactures.—*Ruskin*.

# GRITS AND GRINDS

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*Aluminum*  
*Abrasives*

**A**LL salesmen look alike to the average purchaser of goods. It is only an occasional one who enters an office wearing the halo of an especial charm, that makes the individuality of the man felt before a word is spoken.

To the salesman not gifted with this magnetic distinction, quick wit, diplomacy and a close study of human nature, aided by a knack of putting his bid for favor into the clear, quick language of the living, are assets when one has a line of goods of worthy nature.



## Bevel Flanges Should be Relieved

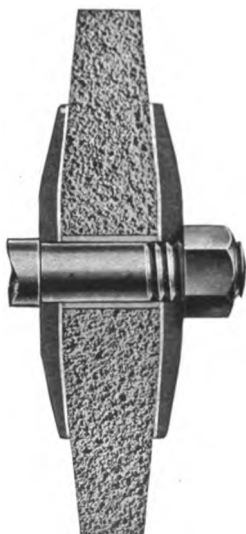
By J. C. Spence, Norton Grinding Co.

**Difficulty of Duplicating Bevels to a "No-limit" Accuracy. Slight Inaccuracy an Unsafe Condition. Relieved Flanges more likely to Hold the Parts, if the Wheel Should Break, Affording Better Protection**

A bevel safety flange, as usually made, may or may not add protection to the user. These flanges have always been made with the assumption that the machinist and the wheel maker would produce the working surfaces to exactly the correct angle.

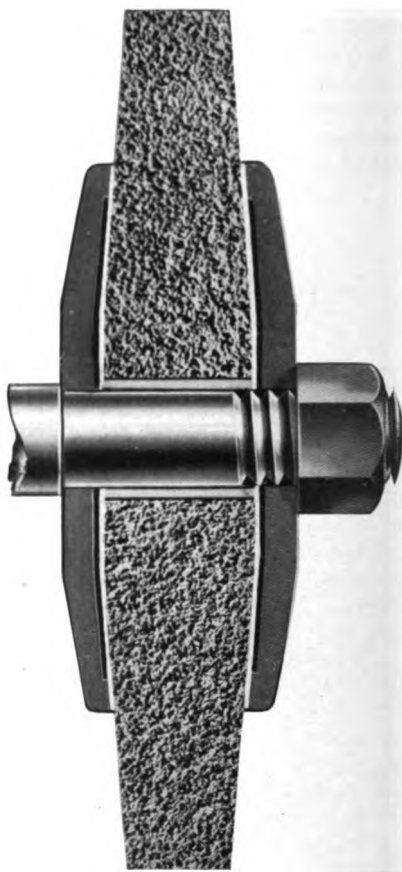
It is an extremely difficult undertaking for the machinist to duplicate these bev-

machines would soon change the straight line element of the cone into a curve.



**Fig. 1**  
**Usual Bevel Flanges**

els to a "no-limit" accuracy. How much more difficult it is for the wheel maker to do so will be self-apparent, when we consider the material with which he deals. Even if a wheel truing machine, when brand new, would produce an exact conical surface, the difficulties introduced by the extreme rapidity of wear in these



**Fig. 2**  
**Relieved Type of Bevel Flanges**

While this error might be slight, yet, taken in accumulation with two other

possible errors in angle, the result may produce anything but "safety."

Figure 1 illustrates a flange and wheel of type in general use.

If the wheel breaks, the added pressure on the small area of contact, near the hole edge, crushes the wheel slightly and allows the broken parts of the wheel to move out radially for a distance depending on the amount of inaccuracy in the angle fit.

This sudden letting go of the broken parts oftentimes enables them to strike a blow that forces them completely out of the flanges, thus destroying the mission of the design.

The proper way to make a bevel flange is shown by Figure 2. Here, the bearing of the flange on the wheel must occur at practically the greatest radius, which means that the broken parts are almost

certain of being held by the flanges.

Note that the face of the working surface of the flange should be slightly curved. This is so machined because it is the natural form to which the flange surface will wear, if continually mounted with wheels that differ from the flange in angle. One wheel will strike the flange at the inner radius of the working surfaces, while another with a different angle will strike at the outer radius.

If the working surface is made conical and the wheel angle does not fit this surface, then the contact between flange and wheel will be a sharp line contact; whereas, if the flange surface is intentionally curved, the surface contact, while theoretically a line contact, will not have the sharp, easily crushed construction of the other style.

## To Enlarge Holes in Grinding Wheels

By G. A. Olia, Norton Co.

### A few Shop Kinks for the Practical Man

There are numerous devices for enlarging the bore or hole in grinding wheels. A taper mandril is suitable and something you can readily make from a piece of steel or chilled cast iron. An old file is very serviceable for such purposes and is something you can more readily locate perhaps than a blacksmith or a foundry.

The half-round file is the best but any can be utilized by using a wooden wedge between two files, thus giving you a chance to adjust for different sizes of holes. Should you wish hole standard size without bushing with lead you can get it by setting your files the desired distance apart and trying out with standard plug until you have a good fit. If wheels with a large bore are a trifle small they can be enlarged enough to fit flange by rubbing with a piece of a wheel or an Alundum brick in this way: take the brick or piece of wheel and rub tightly around the bore taking

care not to rub more in one place than another, blowing or brushing the dust away thoroughly every time you try the flange. This will insure getting a good fit on the flange.

Small wheels can be reamed with a round or square file or Alundum stick, rolling wheel on the bench until size of hole is what you want.

If you are unable to locate a file you can use a round Alundum stick about the size of hole you desire, and with Alundum grain grind the bore in this way.

Making a bore smaller is more of a proposition but can be done if necessary. You can take glue and brush lightly inside of bore, rolling the wheel and at the same time dropping in the bore Alundum grain which will stick to the glue.

When set and hard, rub with Alundum stick as before described.

## Speed 6,000 Surface Feet for Cylindrical Grinding

By C. H. Norton, Norton Grinding Co.

**Many Troubles Result From Running Grinding Machines at the Wrong Speed. Reduction in Speed Below 6,000 Feet Means Less Production. Insufficient Driving Power Sometimes the Cause of Trouble**

The matter of speed of wheels when used with cylindrical grinding machines is very important, and the Norton Grinding Company find it very difficult to secure the proper speed with machines that they send out to customers. Although they have been working at the problem for eleven years, there seems to be new ways of getting into misunderstanding in regard to speed.

The speed desired by the Norton Grinding Company to-day is 6,000 surface feet, and they place such figures for the revolution of the overhead works and motors as to secure this speed of wheel, if the people using the machines follow the instructions. Experience teaches that only once in a while are machines so set up that the speed required is obtained. Engineers, draughtsmen and others who figure pulleys appear to be careless. Either the driving lines of shafting run at different speeds than they are supposed to, and they neglect to find the actual speed, or they make mistakes in figures as to the size of pulleys, so that when our operators come to demonstrate, they find some running faster, but most always running slower. Others assume to know about the speed and differ with us, and set up their machines to run at slower speeds, rarely at faster speeds. But recently we have found a case where instead of 6,000 feet per minute, the wheel was revolving 7,500 feet per minute. At the time our demonstrator visited their plant, when the machine was first set up, they had little or no work for demonstration. He, therefore, did not discover anything at that time. They had been using the ma-

chine considerably over a year and getting poor results from it, their wheel glazing over and causing trouble. But inasmuch as we had insisted that that was the correct wheel, they assumed that the trouble was with grinding itself, and not with any detail connected with either machine or wheel. Recently a demonstrator from our works was sent there to help them out, and he immediately discovered the error in speed and had it corrected. In this case the machine was motor driven. It would appear that the motor was making greater speed than they expected it to make when they notified us in regard to the speed of the motor they intended to use.

In cases where the wheels are running slower than we recommend, heating and warping of the work is quite common, and also slow production. This is due to the loading of the wheel, and the loading is caused by running it slower than that particular grade of wheel should be run on that particular work. So far as the Norton Grinding Company have observed in their experience of ten years, speeds slower than 6,000 feet per minute reduce production and lead to the difficulty of loading.

It is possible that a little more than 6,000 feet per minute is even better. In fact, our machines in many cases are running possibly 6,500 feet per minute, and getting excellent results. It is the belief of the Norton Grinding Company that a variation of 500 feet per minute is not detrimental to success, unless it shall be a reduction in speed below 6,000 feet.

Many users of grinding machines are having trouble because they have insufficient driving power, and when the wheel

is put to work, with the idea of rapid production, the driving power slackens slightly below 6,000 feet per minute, loading occurs and warping of the work, necessitating re-truing the wheel often and great care on the part of the operator to prevent heating and loading. Therefore, reduction of production. Quite a prominent case was one where a ship building concern had a machine for grinding large piston rods. These rods were about 8" in diameter and some twelve to fourteen feet long. They found it impossible to grind these rods and get them round, for the reason that the wheel would grind on one side only at each pass, and on returning would grind on the opposite side. It would never grind continuously all around the circumference. Investigation showed that the belt for driving the main shaft from which the overhead works was belted, had insufficient driving power, and while the grinding wheel when running idle, made the correct number of

revolutions, as soon as it was put to work, the entire system of drive slackened, the wheel loaded, and caused the heating that brought about the grinding of the piston rod first on one side and then on the other, in spite of a large amount of water. They were already using a soft wheel, so that no remedy could be recommended in that direction. It became necessary to radically change the entire driving system.

We would call the attention of all interested, to the fact that when a wheel is recommended of a certain grade for a certain kind of work, with the recommendation is the assumption that the speed will not fall below 6,000 feet per minute, and not exceed 6,500 feet per minute, and that there must be sufficient driving power to maintain that speed through the entire process of grinding. Any variation from these limits will bring about slow production and other troubles which many operators have and do not understand the reason for them.

## Grinding Machines—Not “Grinders”

By C. H. Norton, Norton Grinding Co.

**Not Good Practice to call Grinding Machines “Grinders.” Definition of Universal Machines. Move by Grinding Machine Manufacturers to call Machines by their Proper Names. Names Suggested for Grinding Machines of Various Types**

Would it not be well for us all to pay more attention when talking about machinery to the use of names and terms which are more nearly correct than is common among machinery people?

How common it is to hear a grinding machine spoken of as a “Grinder.” Did you ever stop to think what a grinder is? Is not a grinder a man? Grinders are not made of iron and steel. Grinders are born of flesh and blood and after proper education are experts in grinding or in the operation of grinding machines. They are not the machines themselves, but the operators of them. If it is good

practice to call a grinding machine a grinder, why not call an engine an engineer?

We speak of a “Floor Grinder” and a “Bench Grinder.” Surely neither one of these machines grind floors or benches.

How many people when speaking of a Cylindrical Grinding Machine, call it a “Universal Grinder” when it really is not a grinder nor is it universal,—in many cases, it is not even semi-universal? Many mechanics speak of all cylindrical grinding machines as universal. To be universal, a machine must grind work with parallel sides, taper and conical work,

flat sides of discs (that is, sides of saws; milling cutters, etc.), must grind holes either straight or conical; must grind reamers for clearances as well as for diameter; must grind clearance on milling cutters; must grind rectangular flat surfaces and angular flat surfaces, and, in fact, all regular forms; and some might contend that to be practically universal it must grind irregular forms mechanically. The writer believes, however, that considering the state of the art of grinding, it would be sufficient to limit the universal machine to all regular forms, and any machine, from which one or more of the forms mentioned is omitted, must be a semi-universal machine and when that machine is limited to grinding external diameters and has possibilities for grinding a limited taper, it cannot truthfully be called a semi-universal machine, but it would more naturally be called a cylindrical grinding machine.

How common it is that surface grinding machines, which have for the grinding member a disc covered with emery cloth, are called "Disc Grinders" when they do not grind discs, but do grind flat surfaces? Would it not be better to call them "Surface Grinding Machines, Abrasive Disc Type?"

At the recent meeting of the Machine Tool Builders' Association, there was present a large number of manufacturers of grinding machines, and when considering the classification of machines, it was decided by this gathering that the proper name for the so-called "Floor Grinder" was "Grinding Wheel Stand Floor Type," and for the so-called "Bench Grinder" was "Grinding Wheel Stand Bench Type."

It was also decided upon the name "Cutter Grinding Machine" for all machines on which cutters were ground and "Cylinder Grinding Machines" for all machines designed especially to grind internal cylinders, for motors, etc.; "Polishing Stands" for all machines for simple polishing; "Surface Grinding Machines" for all machines using the periphery of the grinding wheel for grinding flat or rec-

tangular flat surfaces, and "Surface Grinding Machines, Vertical Spindle" when using the side or ring wheel, and "Surface Grinding Machine, Abrasive Disc Type" when using the well known disc covered with emery cloth, and "Surface Grinding Machine, Rotary Table Type," when the table revolves; and when machines are designed especially to grind the sides of saws, milling cutters, sides of discs generally, and not universal in their nature, the name "Disc Grinding Machine" was adopted; and when grinding machines are made for grinding internally or externally, using more than one grinding wheel simultaneously, they were called by this committee "Multiple Spindle Grinding Machines;" and machines such as made by Norton Grinding Company, Brown & Sharpe Manufacturing Company, Landis Tool Company, and others, for grinding external round work were called by this committee "Cylindrical Grinding Machines," which name, of course, has a broad application and will cover both plain machines and semi-universal.

Tool grinding machines were defined by the committee as machines to grind tools only, and tools in this instance, the committee decided, are lathe and planing machine tools. This would indicate that the best name for the universal machine, as built, for instance, by Norton Grinding Company, would be "Universal Grinding Machine" and is universal because it will grind any regular form, whether on tools, cutters or whatever article; but a Tool Grinding Machine, so called, is one (according to the decision of the committee) that is designed especially to grind hand tools; that is, those tools used in lathe and planing machine work.

The writer thinks, when we all consider this question soberly, we must admit that the machinery business is worthy of as much refinement as any profession in the world, and if we wish it to hold its place and command the respect and have the dignity that it deserves, we should, at least, respect the language, which it also deserves, and therefore should not use the

word "Grinder" when we really refer to the grinding machine and not the operator. In referring to a pair of skates, we certainly would not call them a skater, for every one would believe we were speaking of the man who was using the skates. We might carry these comparisons farther, for the writer feels quite certain that machinists are guilty of more confusion of terms, names, etc., in connection with their business than others. Let us endeavor to raise our calling out of the crude language in which we now find it. The name "Dog," we all know, is used freely for almost everything that goes into the construction of machinery and has about as much meaning to us as "Hindu." Nobody, except each individual mechanic who applies that name to some object in the machine where he fancies, knows what he means. This matter of fancy in giving names to machines and parts of machines should, in the interest of im-

provement, be discouraged. If the outside world were not extraordinarily patient with us, they certainly would be vexed when reading our literature or listening to our conversation. It is so meaningless to anyone but ourselves, and even among ourselves many times it requires considerable explanation before other mechanics can understand our meaning.

While it is a large subject, the writer feels that we certainly can cease calling Grinding Machines "Grinders" and if any of us are so tired when talking that it causes us an effort to say "Grinding Machine," rather than the one word "Grinder," it would seem a pity.

It appears that these expressions have crept into our mechanical phraseology because of our desire to economize in words and time, but is not that carrying the economy of words and time to the extreme?

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## Chas. Churchill & Co., Ltd.

**How a Successful Enterprise was Developed from a Single Idea. Sole Agents  
for Norton Grinding Wheels in United Kingdom. Distributing  
Points in Leading Cities**

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The above company, who have been the leading representatives for Norton Grinding Wheels in Great Britain for more than twenty years, were recently appointed sole agents for the United Kingdom.

The firm name, Charles Churchill & Co., Ltd., is a familiar one to large manufacturers in United States and Great Britain, as this firm represents many of the largest manufacturers of American machinery. The head offices are at London with distributing points or branch sales offices at Birmingham, Manchester, Glasgow and Newcastle-on-Tyne.

Mr. Charles Churchill, the present managing director, was born in Hamden, Conn., in 1837, and began his career in the

business of his father in the manufacture of augers, bits, etc.

While engaged in a business venture which took them to London in 1861, they conceived the idea of selling American tools in Great Britain. From that idea has developed a remarkably successful enterprise. The firm of Charles Churchill & Co., Ltd., started the business of importing American tools in 1865 and they claim the distinction of being pioneers of the trade.

For a few years the business was mostly confined to small tools such as Twist Drills, Chucks and other Engineers' tools. Then followed the introduction of Brown & Sharpe's Milling Machines and Screw



**Mr. Charles Churchill and Sales Force of Charles Churchill & Co., Ltd.**  
 whose energies are resulting in a constantly increasing demand  
 for Norton Grinding Wheels in Great Britain

Machines, also Pratt & Whitney Lathes, Drills, etc.

A Limited Liability Company was formed in 1889 the capital of which has three times been increased and now stands at \$600,000 and the business is steadily enlarging.

Three sons of Mr. Churchill are at present engaged in the management of the business which comprises a staff of 120 employees.

The above photograph was taken at Manchester, England, recently during a Sales Conference of travelling men and office managers.

Mr. A. C. Scott, travelling representative of Norton Company in Great Britain, was present and delivered an illustrated talk on Grinding Wheels and Machinery.

#### NEW GRINDING DEVICES

Automatic Saw Sharpener by Nutter & Barnes Co., Boston, Mass. These machines are built in sizes ranging from 12 to 20" diameter and 12 to 36" diameter, equipped with regular saw gumming wheel and two narrow 4" grinding wheels.

Valley City No. 24 Grinding Machine by Valley City Machine Works, Grand Rapids, Mich. Sizes of wheels recommended for this machine are 24" in diameter, 4" thick.

A special taper grinder intended for grinding cock plugs or tapers of 15 to 45 degrees and up to 4" in length is manufactured by the Black Rock Machine Co., Bridgeport, Conn. A large cup grinding wheel is used.

# GRITS AND GRINDS

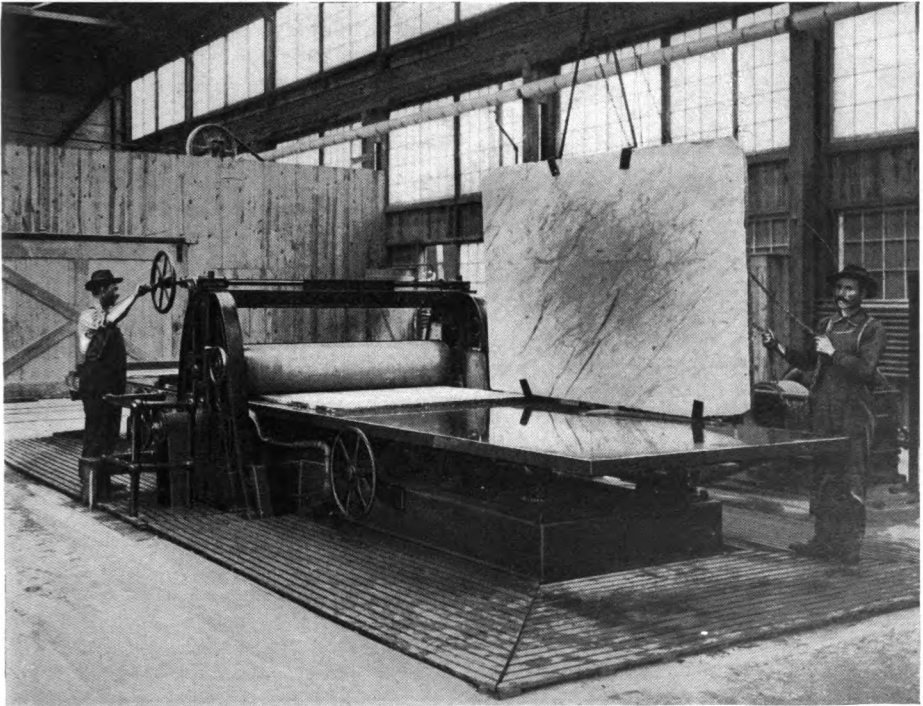
A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
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1911

June

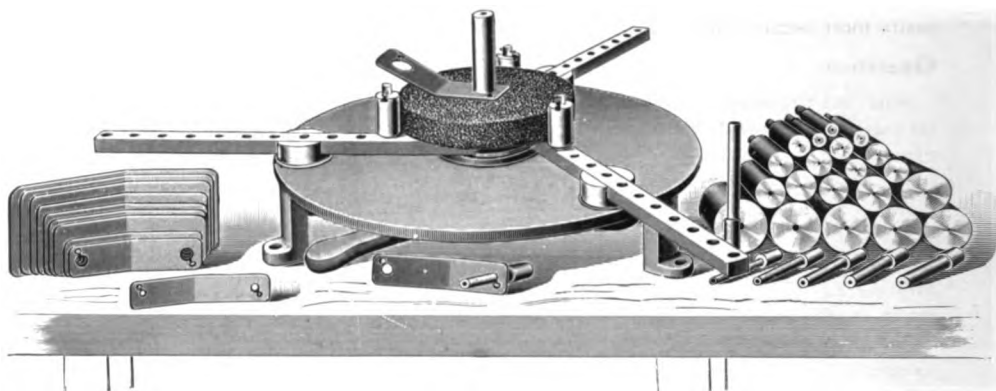
1911



## THE DRUM RUBBER

A Machine for Bringing Slabs of Marble to a True and Smooth Surface  
Believed to be the Largest Grinding Machine in Existence  
Description on Page 3





## Bushing Grinding Wheels

By G. A. Olin of Norton Company

**Hardness of Lead Judged by the Color. Babbitt Bushing Better Adapted for Cup Wheels and Coarse Wheels. Bushing Instructions. Importance of Trimming Bushing. Troubles Caused by Poor Bushing**

While it is of the utmost importance that grinding wheels should be properly bushed, very crude and inefficient methods are in use in many places and it is not surprising that grinding wheel troubles result.

The suggestions given here are based on the bushing methods in vogue at the Norton plant where bushing chucks of the type shown here are used. The first requisite for bushing wheels is a chuck of this or similar type in order that the hole may be centered. These chucks are manufactured by Norton Company and sold by Norton agencies.

### Uniform Hardness of Lead

This can be judged by the color. Soft pig lead has a greenish purple tinge when hot. This is too soft for the bushing to retain its shape and it will not stand careless handling when placing on a machine spindle.

Frequently, the complaint that a wheel is "out of truth" is caused by the bushing being too soft. The lead when hot enough to bush with should be of a grayish color.

### Bushing with Babbitt

This is a much harder material and, therefore, better adapted for bushing cup wheels with large overhang. Very coarse wheels that are subjected to hard pressure on the periphery stand up much better if bushed with babbitt.

### Position of Wheel When Bushing

One should be careful to see that the wheel lies flat on the bushing chuck; then move lever on chuck until the wheel is gripped tight, being careful to see that you do not raise the wheel from the chuck, otherwise you will have a lot of lead on the under side of the wheel.

It is advisable to remove the blotters from sides of wheel before bushing.

If you do not care to do that make a paper collar the same thickness as the blotters and small enough to go inside of hole in blotters and fit on the arbor. This will keep the new lead bushing even with the old one and will save trouble with wheel running out on the sides. It is also advisable to put two or three notches in the old bushing, with a ham-

mer and chisel, to make the new lead unite more securely with the old.

### Operation

First get the arbor of the size you desire to use and see that it fits in taper hole of chuck. After you are satisfied it fits, take out arbor, place wheel flat on chuck and move lever until tight. Then put in the arbor, slip the bushing cleaner over the arbor, holding it down firmly on the wheel. Fill the ladle with lead and pour it through cleaner hole into the wheel. Let it cool half a minute, turn the cleaner so as to cut off pouring tap, take off the cleaner, remove wheel from chuck and rest it on the floor or bench while you drive out the arbor.

### Trimming the Bushing

It is important that the lead bushing does not protrude outside of the wheel. It is, therefore, necessary to trim off the bushing with a chisel even after a cleaner has been used as the lead will sometimes be above the side of the wheel.

### Troubles Caused by Poor Bushing

When wheels are not properly bushed,

they will run out of truth on the sides, which indicates that the hole is not at right angle with sides of the wheel. In mounting the wheel, a careless operator might not notice such a condition, and tighten the wheel up against the stationary flange on his grinding machine spindle. Usually this breaks the wheel, but if it does not, the wheel is very liable to break when it comes in contact with the work.

It is more dangerous when the wheel does not break when mounting as placing it in contact with grinding work places extra strain on it, and the wheel breaks when revolving.

Another cause for breakage at times is bushing left sticking out on the sides of grinding wheels. If they are mounted with lead bushings protruding, pressure on the lead, when the wheel is tightened in place, is sufficient to break wheels, or put such additional strain on them that they will break later while in use.

Sometimes, when wheels are piled one on top of another, a protruding lead bushing in the pile will cause such a strain from weight of wheels on top, that a soft or thin wheel will break under it.

## Grinding Wheels in the Marble Industry

By J. Royden Peirce  
of Royden Marble Machinery Co., New York.

**Marble Industry Revolutionized by their Use. The Drum Rubber—the Largest Grinding Machine in Existence. Finish Left by Crystolon. Crystolon in Coping and Moulding Work**

Though the average person is more or less familiar with abrasive wheels in the grinding of metals, few realize the fact that the marble industry is being revolutionized by their use.

Of the many machines and processes none is more interesting than the surfacing machine made by the Royden Marble Machinery Company and known as the Drum Rubber. It is designed to take the place of the present rubbing beds, in bringing slabs of marble to a true and smooth surface, and, as far as the writer

is aware, it is the largest grinding machine in existence.

It consists of a great roller of CRYSTOLON placed between two massive iron tables. The slab is pushed over this abrasive cylinder from one table to the other, the drum grinding its under surface during the journey. A rubber covered idler is held directly over the latter and keeps the marble in engagement with it. This idler is very carefully weighed to just balance the up-thrust of the drum in order to prevent any traverse strains in the

slab. So successful has the design been, that, not only can fragile marbles be successfully rubbed, but even glass in large sizes and only  $\frac{1}{4}$ " thick is passed through the machine without difficulty. Indeed, it is hoped that this scheme will effect as great a saving over present methods in the glass industry as it has in the marble.

The surface which CRYSTOLON leaves on the marble is what is known as a "spine finish" and resembles fine woven silk. It is really composed of minute scratches and, strange to relate, has the double property of protecting the marble during shipment or storage and also enables gritting, or polishing rings to grip the

marble much better than the old smooth finish left by the rubbing beds.

The massive drum weighs 1,800 lbs., but is balanced so perfectly that no vibration is experienced by the slabs which pass over it. Furthermore, the proportions have been very carefully designed in order to avoid critical velocities.

An excellent example of the work of this machine is to be found in the New Public Library which has recently been opened in New York. Over 60,000 square feet of tile were used in this building, all of which was finished on the Drum Rubber.

While this description has been confined to the use of CRYSTOLON in surfacing marble, this wonderful abrasive is also very useful in coping and moulding work.

## Norton Products Exhibited at Foundrymen's Convention

Much Interest Shown in Norton Crystolon Wheels for Foundry Work  
and the New Line of Norton Alundum Refractories  
Successful Convention and Exposition

A display of CRYSTOLON wheels suitable for ordinary foundry work, and ALUNDUM wheels for steel foundry work, with ALUNDUM and CRYSTOLON rubbing bricks, oilstones and grain material, and a complete line of the new Norton Alundum Refractories, composed part of the Norton exhibit which attracted favorable attention and comment at the Western Pennsylvania Exposition Society Building, Pittsburg, from May 23 to June 1.

The Exposition, under direction of the Foundry & Machine Exhibit Co., was favored with 111 exhibits, including those of machines and appliances for all branches of foundry work, notable among which was an exhibit from the Norton Grinding Co. of a two-inch floor grinder, equipped with protection hoods, and ALUNDUM and CRYSTOLON wheels.

The Norton wheel exhibit was supplemented with exhibits of ALUNDUM Valve Grinding Compound, and a large case of beautifully tinted CRYSTOLON crystals, which attracted much attention because of their brilliancy.

It was gratifying to those in charge of the Norton booth, to note the attention and interest shown the exhibit of ALUNDUM Refractories. Many questions were asked of the booth attendants, and were answered as fully as possible in each case. The refractory utensils, with an explanation of their utility, caused much favorable comment from the members and their guests, who came from all parts of the United States, and some from Canada, comprising superintendents, officials, foremen, chemists, metallurgists and asayers.



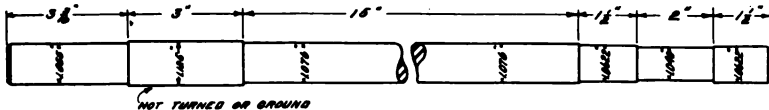
During the Exposition, there were held the annual conventions of the American Foundrymen's Association, the American Brass Founders' Association, and the American Foundry Foremen's Association, as well as the summer meeting of the American Society of Mechanical Engineers.

These meetings were held in the large auditorium of the exposition building, which served to keep the members and their friends in close assembly, and permitted them to view the exhibits to best advantage.

## Straight Lathe Finishing vs. Lathe and Grinding Finishing

That the difference in cost between lathe and grinding machine finish and straight lathe finishing on steam turbine engine shafts, amounts to  $33\frac{1}{3}$  per cent. in favor of lathe and grinding, even

engines, tests were made. The grinder was new to his machine. The straight lathe finish work figured up to 30 cents for each shaft, while a finish produced by lathe work and grinding, figured



under unfavorable conditions, has been proven by reports received from a large Chicago factory by the Norton Grinding Co.

In finishing up shafts for steam turbine

engines, tests were made. The grinder was new to his machine. The straight lathe finish work figured up to 30 cents for each shaft, while a finish produced by lathe work and grinding, figured up to 20 cents. The machine man's report was that it will cost still less for lathe work and grinding when the man becomes familiar with manipulating the grinding machine.

In finishing up the shaft with a combination of lathe work and grinding, the lathe work figured up to cost eight cents on each shaft, and the grinding finish work figured up at 12 cents for each shaft, a total of 20 cents. In straight lathe finishing the lathe work figured up to cost 30 cents.

The man operating the grinding machine had been on that work but five weeks, but was showing evidence of increasing speed for the near future, to reduce the cost still more, when the test figures were taken.

## The Re-Balancing of Wheels

**Running Balance Necessary in Cylindrical Grinding. Wheels Balanced with Lead, should be Re-Balanced after Reduced in Diameter**  
**Methods of Balancing. Balancing Stands**

In order to get first-class results in cylindrical grinding, and in fact, in any grinding, the entire revolving mass, made up of the spindle, spindle pulley, wheel sleeve and wheel must be in running balance.

If the spindle and its parts are once in balance, they will remain so. This is not true of the wheel. A glance at Fig. 1 will show the reason for this.

The dotted circle shows the original diameter of the wheel. At the left was a portion of the wheel more dense than the rest of the mass. This required a lead counter-balance, as shown, in order that the wheel should be "in balance."

No matter how accurately this counter-balance is made, when the least portion of the periphery is worn away or trued off, the wheel is again "out of balance," because the mass of lead remains constant—while the dense portion is a decreasing

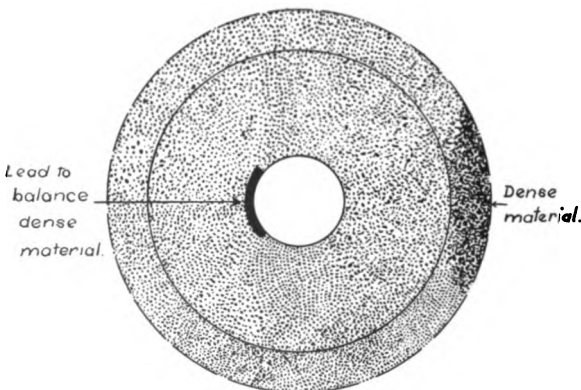


Fig. 1

The spindle, together with its parts, must actually be in running balance. A standing balance only will not do. In the case of the wheel, if it is not over 4" wide, standing balance is usually enough to give good results. If standing balance does not remedy the trouble and you know that the other parts are in running balance, then the wheel also requires to be put into running balance.

factor.

Every wheel made in the world, to-day, is subject to this unequal distribution of material.

It is a condition that scientific thought and care, as evidenced at the Norton Works, will keep down to a minimum, yet, it does exist, and must be considered as being one of the "things that are."

Some firms have recommended that the

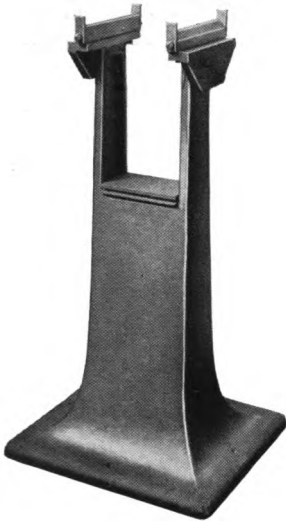


Fig. 2

wheel sleeves be equipped with weights that can be shifted, added to or subtracted from, as the wheel wears.

If each wheel in a factory was mounted on its own individual wheel sleeve and a reliable person was appointed to inspect and adjust these weights, this scheme would work within certain limits. But since wheel sleeves are expensive, and no firm that we know of has one for each wheel in its possession, it is at once evident that each time a wheel is mounted on a wheel sleeve, the weights will require re-adjustment. This means that the grinding machine must stand idle until such time as the person doing the balancing is satisfied with the results of his re-adjustment. If the concern has installed a number of machines, it will quite frequently happen that an operator will have

to wait longer than the mere time to balance his sleeve alone, as there will sometimes be another operator with a wheel to "doctor."

To let each operator do his own balancing would not be wise, as an operator is hired to get out ground pieces in the least possible time, especially if he is working by the piece, and he will not have a regard for exact truth as will the chap who is hired to really balance the wheels.

Furthermore, the loss in production, due to the operator leaving his machine, is against all business sense.

Again, the adjustment of weights in the sleeve, unless these weights are in the central plane of the sleeve, is contrary to dynamic laws for obtaining a condition of running balance, because, if the weights are outside of the central plane, there are "force couples" set up which throw the whole rotating mass out of running balance.

At the Norton Grinding Co. plant it has been found to be entirely satisfactory to re-balance the wheel itself, either by the addition or the removal of lead. Our practice is to send every wheel that shows any signs of being out of balance to a department that is properly equipped for the work. We do this in the incipient stage of the disease, when cure is a simple matter, and only after we have finished a job, so that there is no delay occasioned by the wheel being in the "hospital."

Each wheel in the shop is given a serial number and a record sheet is kept, showing the date when re-balanced and also the amount out of balance. Below is a typical tag of such a wheel. Examination will show that we consider a small amount to be detrimental to the success of the wheel.



Fig. 3

| Wheel No. 71.            |         |                 |
|--------------------------|---------|-----------------|
| Re-balanced              | Date    | Ounces out      |
| 16 $\frac{1}{4}$ x 2 x 5 | 5-8-11  | 1 $\frac{1}{2}$ |
| 15 $\frac{3}{4}$ x 2 x 5 | 5-17-11 | $\frac{1}{2}$   |
| 15 $\frac{1}{2}$ x 2 x 5 | 5-22-11 | $\frac{1}{4}$   |
| 15 x 2 x 5               | 6-10-11 | 0               |

For the delicate determination of balance, the ordinary "balancing ways" are not good enough. Their run-ways are too broad so that they catch dust. Also, the large diameter arbors generally used are not sensitive enough.

Figure 2 shows a small balancing stand with *hardened and ground very narrow round edged ways* that is in use at the Norton Grinding Co. plant. Figure 3 shows the arbor used for wheels having 5" diameter holes. Note the small diameter of the journals that roll on the ways.



Fig. 4

This arbor is also *hardened and ground and both balancing ways and arbors are carefully boxed, when not in use*, to preserve them from accident.

While we are on this subject of balancing stands it will be appropriate to point out a short cut to determine the heavy side of the wheel without waiting so long for "the old cat to die," as the children say about their swings.

It is the usual practice to allow the wheel to oscillate on its arbor, in the stand, until it comes to rest with the heavy side down. If you will hold a piece of chalk with steady hand, just above the centre of the arbor, and lightly chalk-mark the wheel near the face just as it turns to move in the other direction, you will mark one limit of the movement. By keeping the hand in the same place and again chalking at the other extreme end of the movement, you will have the arc that the wheel moves through. Half way between these two marks, and directly opposite, is the heavy spot. This operation is being performed in Fig. 4.

#### NORTON LABORATORY APPLI- ANCES INTEREST MEMBERS OF AMERICAN CHEMICAL SOCIETY

"Refractory and Laboratory Appliances made of Alundum" is the title of a paper read by Mr. P. A. Boeck of Norton Company's Laboratories, at the Summer meeting of American Chemical Society in Indianapolis which was in session from June 28th to July 1st. Mr. Boeck's paper, which brought out the advantages of the new Norton line of Refractories, proved to be of unusual interest to the 400 members present, and opened up a wide discussion.

Mr. N. C. Hilton of Norton Company was also present with a complete line of samples of Norton Alundum Refractories, which exhibit created a good deal of interest.

The Black Rock Machine Co., Bridgeport, Conn., are putting out a special grinding machine intended for grinding taper plugs or similar parts up to 4" in length. A large cup wheel is used.

# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

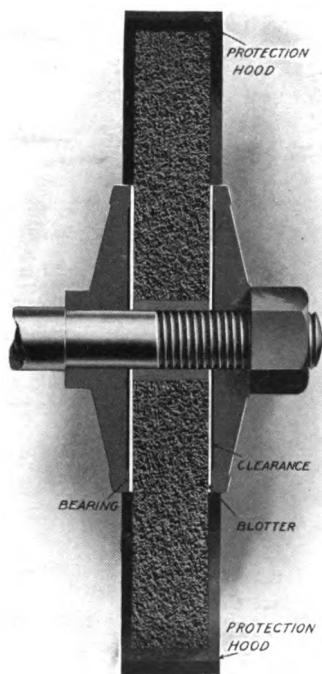
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## SAFETY NUMBER



### Correct Grinding Wheel Mounting

Relieved flanges one-half the diameter of wheel—compressible washers between wheel and flange—perfect bearing on outer edge of flange—inner flange keyed or shrunk on spindle—wheel surrounded by protection hood.



## Safety as Applied to Grinding Wheels

This is the title of a book recently issued by Norton Company, illustrating and describing modern devices for the prevention of accident and protection to workmen which can be practically applied in the use of grinding wheels and grinding machines. The illustrations in this issue of "Grits and Grinds" are reproduced from the book.

We will be very glad to send, without charge, copies of the book to any one on request.

### NATIONAL INTEREST IN ACCIDENT PREVENTION

Interest in accident prevention and relief in all its phases is rapidly increasing in volume and extent both in this country and abroad. Many progressive manufacturing concerns have established in their plants private systems of relief and prevention which have attracted national attention. Many have issued books on the subject containing rules and instructions to employees for the prevention of accident, and making superintendent, foreman or other men in charge directly responsible for the carrying out of these rules and regulations.

The National Association of Manufacturers of the United States has taken an interest in this subject to the extent of publishing a book entitled "Accident Prevention and Relief," which is a thorough report of an investigation of the subject by Ferd. C. Schwedtman and James A. Emery. This book should be on the shelf for handy reference by every employer of labor.

That this subject is one of national importance is evident from the fact that accident prevention institutions are maintained in various cities of the world, notably Amsterdam, Paris, Brussels, Berlin, Munich, Vienna, Budapest, Zurich, Milan and New York. In recent years, important International Conferences have dealt with the important phases of

accident prevention, compensation and insurance.

Believing that the old adage "An Ounce of Prevention is Worth a Pound of Cure" very forcibly applies in the matter of protection against accidents, we are preparing to establish in our works, our branch stores and other prominent places, standard exhibits of safety devices as applied to grinding operations. One such exhibit is now on display at the American Museum of Safety, 29 West 39th St., New York City.

It is important that every employer of labor and employee visit, at every opportunity, exhibits of safety devices particularly those relating to the industry in which he is interested or employed.

### METHODS OF MOUNTING GRINDING WHEELS

The grinding machine should be of rigid construction, with large spindles, well-fitted bearings and securely fastened on firm foundations. The following sizes of spindles are common except where the grinding wheels are extra thick.

| Wheel             | Spindle          | Wheel                 | Spindle                |
|-------------------|------------------|-----------------------|------------------------|
| 6" diam. and less | $\frac{1}{2}$ "  | 16" diam. and less    | $1\frac{1}{2}$ "       |
| 8" " "            | $\frac{3}{8}$ "  | 18" to 20" diam.      | $1\frac{3}{4}$ "       |
| 10" " "           | $\frac{3}{4}$ "  | 22" to 24" "          | 2"                     |
| 12" " "           | 1"               | Larger than 24" diam. |                        |
| 14" " "           | $1\frac{1}{4}$ " |                       | $2\frac{1}{4}$ " to 3" |

### FLANGES

Flanges should be relieved and at least one-half the diameter of the wheel with true bearing at the outer edge. Inner flange always fixed on spindle, never loose. Never use flanges less than one-third the diameter of the wheel.

Wheels must not be allowed to run when held only by a small nut instead of a flange as the nut is liable to crawl and cause accident.

### WASHERS

Compressible washers of pulp or rubber, slightly larger than flanges, should be used between the wheel and flanges. They distribute the pressure evenly when

the flanges are tightened by taking up any imperfections in the wheel or flanges.

The hole in the wheel should be bushed .005" large over standard size spindles. This permits the wheels to slide on the spindle without cramping and insures a good fit not only on the spindle, but against the inside flange, which is essential.

Tighten flanges only enough to hold wheels firmly, avoiding any unnecessary strain. The importance of this statement is emphasized by the fact that on a 1½" grinding stand, floor type, equipped with 8" standard relieved flanges a man with a two-foot wrench can easily exert a crushing pressure between the wheel and flanges of 3,600 lbs. or over one and one-half tons. Therefore any unevenness between wheel and flanges is liable to cause accident under this side pressure.

#### RIGHT AND WRONG METHODS OF MOUNTING

The accompanying illustration shows the right and wrong methods of mounting wheels. Note in the illustration on the left, relieved flanges with compressible washers between wheel and flange, and a perfect bearing on the outer edge. Note on the right, improper mounting—straight flanges with no washers.

Tightening of the nut causes straight flanges to become slightly convex and instead of the pressure being distributed evenly over the whole bearing surface of the flange it is concentrated near the hole, creating a dangerous condition.

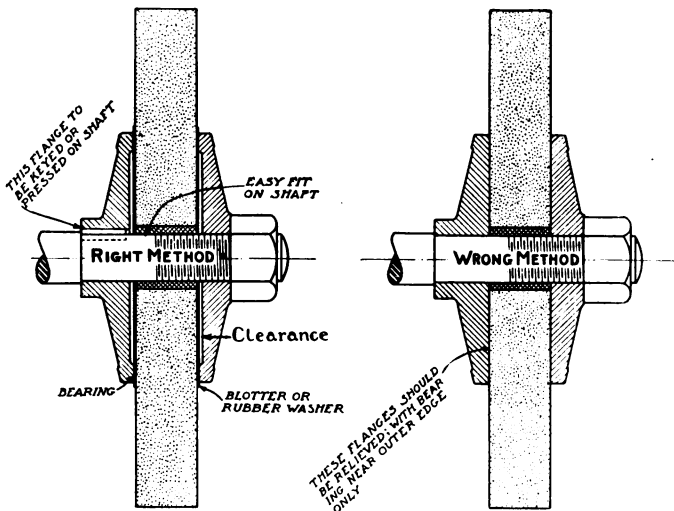
The inner flange should never be left loose on the spindle as in this case, but should be keyed or shrunk on. The rest should be adjusted as closely as possible to the wheel to prevent work from being caught between the wheel and rest.

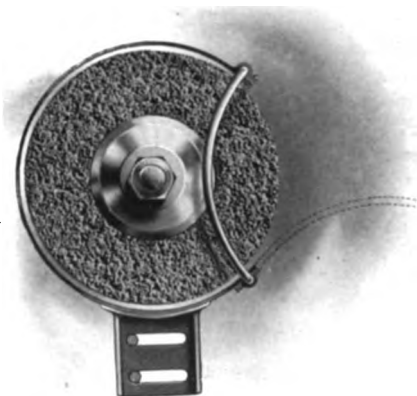
#### PROTECTION HOODS

These hoods are steel bands that surround the periphery of the wheel and in case of accident stop the broken fragments. They are the only safety device that give full protection to the operator and others about him.

Hoods are made in many different types, all of which afford good protection to the operator.

The type shown on the following page has been used for fifteen years and the manufacturers know of no operator of a grinding machine equipped with one of them that has been seriously injured by a broken wheel.





Protection Hood

### GLASS SHIELDS

A shield of clear plate glass affords protection to the workman's eyes where fine work is ground and it is necessary for the operator to work close up to the wheel.

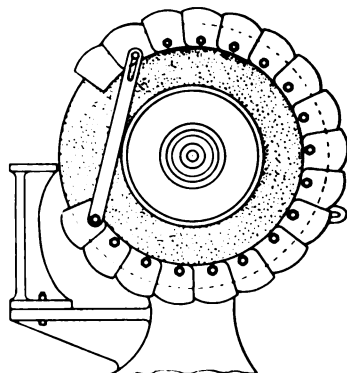
### LEATHER SPARK BRUSH

Where it is impracticable or undesirable to use a glass shield an effective guard may be made of leather. It is nothing more than a leather flap attached to the hood and adjusted so as to interrupt sparks and dust.

**GLASSES**  
Common stone mason's glasses, or goggles of different types afford excellent protection to the eyes.

### EXHAUST SYSTEMS FOR DUST AND GRINDING CHIPS

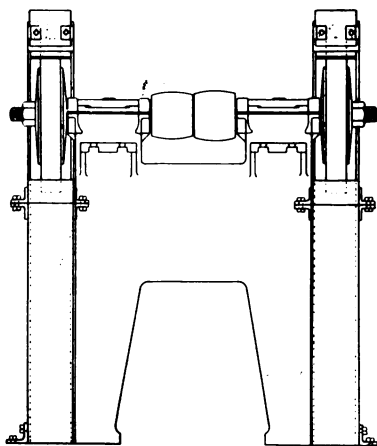
Grinding rooms should not only be well ventilated and well lighted but the machines should be attached to an exhaust system. Besides protection to the



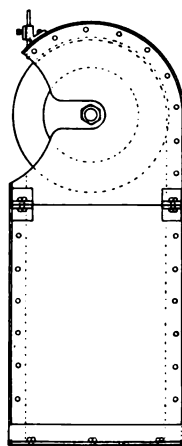
Flexible Adjustable Link Guard

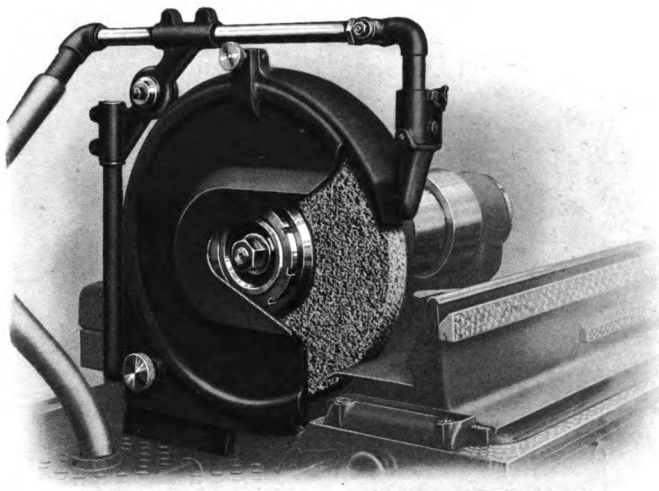
workmen, this system prevents wear and tear on machinery and belts.

There are many efficient and practical types of these systems.



Unique type of Protection Hood for Floor Stand





Protection Hood Used on Norton Plain Grinding Machine

### SPEED CHANGING

As a wheel wears down the speed should be increased in order to maintain the same surface rate and preserve uniform conditions in grinding.

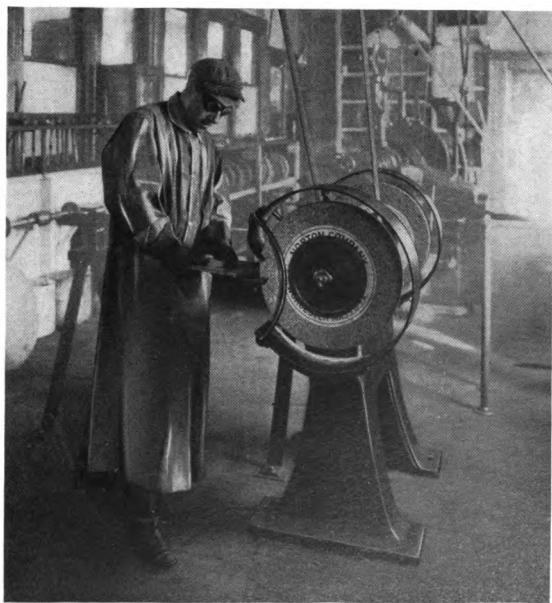
Usually when a wheel is nearly worn out, the spindle is running at the highest speed. If a thoughtless operator takes off the stub of the old wheel and puts on a new wheel without re-adjusting the belts, an accident from over-speeding may result.

A locking arrangement may be used on cone pulleys. It eliminates danger from over-speeding.

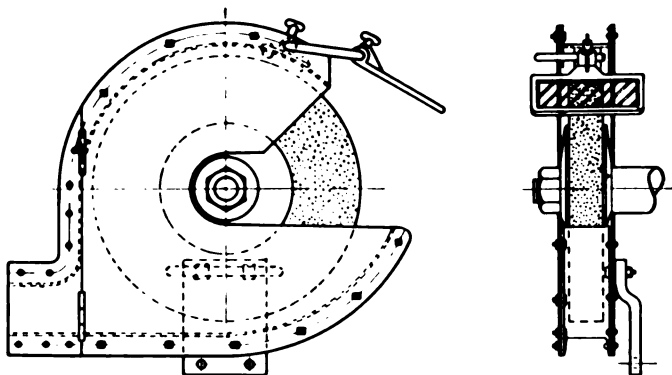
In many shops instead of shifting the belt, two or three sizes of machines are used running at different speeds. When a wheel is worn down to a certain diameter it is changed to a spindle of higher speed. These machines are equipped with a device to prevent

wheels over a fixed diameter being mounted.

Operators should not be allowed to grind until the man in charge knows that the speed of the wheel is right.



Ample Protection—Note the Hood, Leather Spark Brush and Goggles



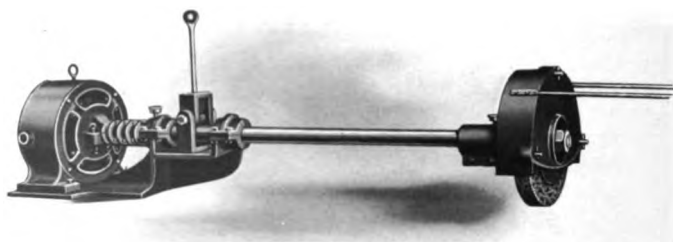
**Riveted Steel Hood with Exhaust Connection and Glass Shield  
for the Protection of Operator's Eyes**

It is recommended that the belt be locked so that speed cannot be changed by the operator.

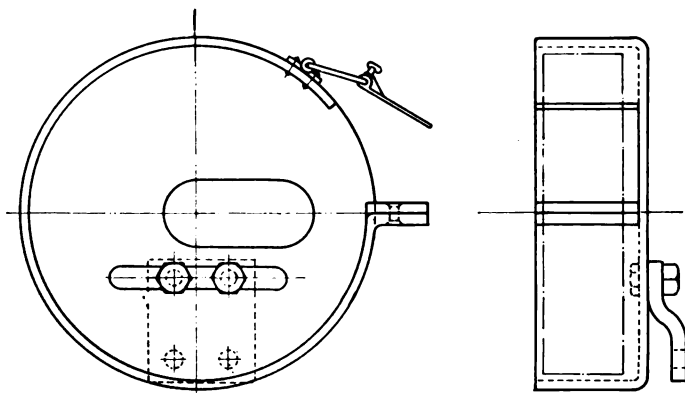
### GENERAL SUGGESTIONS

The foreman of the grinding department,

or his assistant, should examine carefully each morning every grinding machine in the department to see that the bearings are tight and well oiled, and that the wheels are in good condition. He should examine every wheel before it is put on an arbor.



**Special Swing Frame Grinder equipped with Protection Hood**



**Pressed Steel Hood, with Glass Shield. Open side may be covered and  
exhaust connection applied if desired**

The man in charge of the storeroom should carefully inspect every grinding wheel before it is given out to the workmen.

Competent men should be detailed to mount and true grinding wheels, to adjust rests and regulate the speed.

Bearings should be well oiled and carefully adjusted.

Grinding wheels should be stored in a dry place.

A wheel used in wet grinding should not be left over night partly immersed in water.

chine the revolutions of spindle and size of wheel to be run upon it.

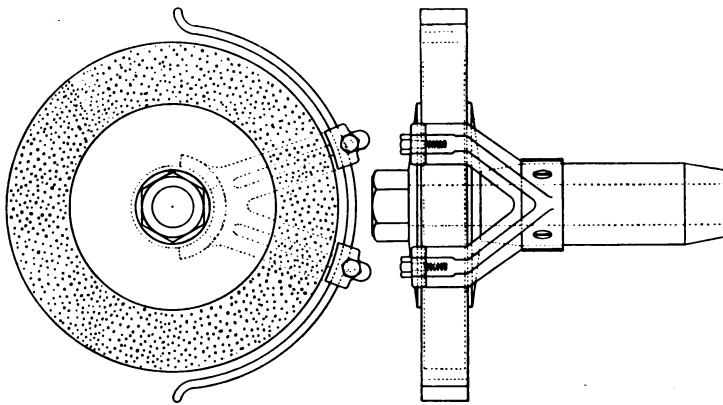
Wheels should be handled with greatest care in unpacking, storing, delivering, etc.

### TESTING FOR SAFETY

Responsible grinding wheel manufacturers use every possible precaution against shipment of wheels that are not perfect.

The following details of testing methods apply to the system used by the Norton Company.

Wheels larger than 5" diameter are



How Protection Hood may be adapted to Flexible Shaft

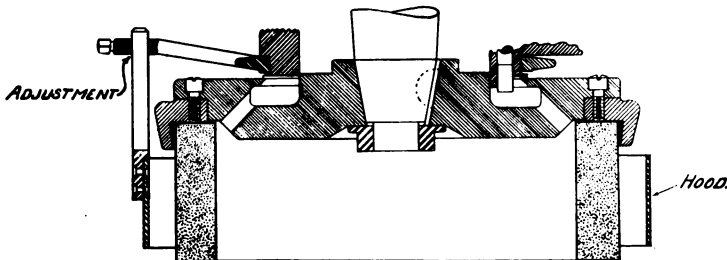
If a grinding wheel vibrates there is something wrong. You should true up the wheel and re-babbitt the bearings after truing up the journals.

Keep all rests adjusted close to the wheel so that work cannot be caught.

Foremen should indicate on each ma-

tested at 9,000 surface feet per minute. As the usual working speeds are from 5,000 to 6,000 feet, these tests insure an ample factor of safety.

The testing machines in use are equipped with variable speed motors and connected with tachometers which accurately register

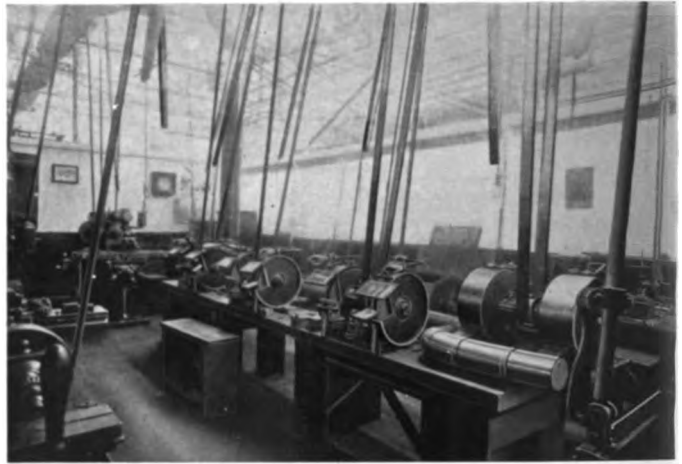


Protection Hood can be used on Surface Grinder

the number of revolutions at which each wheel is tested.

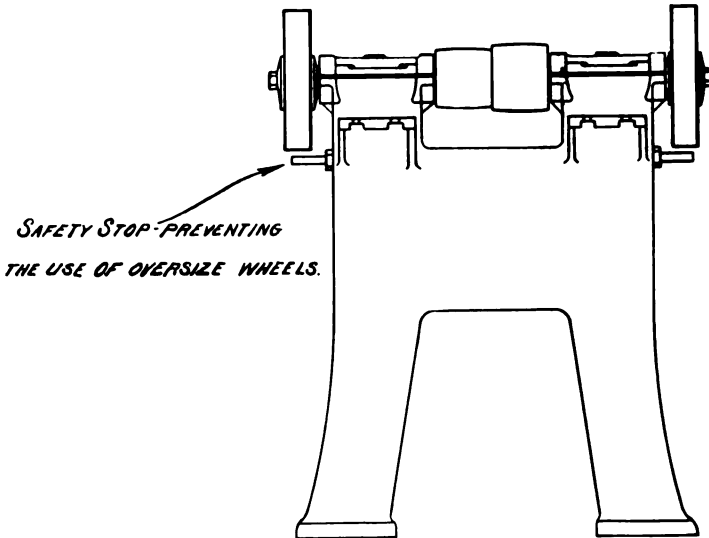
Details of every test are kept for reference. The tested speed is marked on each wheel and a record of the test is made on both the shipping check and the blank shown here. This record contains dimensions of the wheel, grade, order number, name of customer and number of revolutions at which the wheel was tested.

Wheels made with a bond having high tensile strength and wheels made of fine grain have a higher factor of safety than what are known as soft wheels and coarse wheels.



A Model Installation of Nail Die Grinders. Note Safety Hoods, Plate Glass Guard, Exhaust Connections and the Arrangement of Lights

|                                             |
|---------------------------------------------|
| Machine Number.....                         |
| Spindle Revolutions.....                    |
| Diameter of Wheel.....Inches                |
| Take off Wheel at.....Inches                |
| Notify Foreman when Wheel<br>Needs Dressing |



Device to Prevent Use of Wheels above a Certain Diameter

The above notice, hung directly in front of grinding machines, is used in many shops with good results. Where workmen of many nationalities are employed, notices should be printed in their several languages.

# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

UNIVERSITY OF ILLINOIS  
LIBRARY-CHEMISTRY

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1911

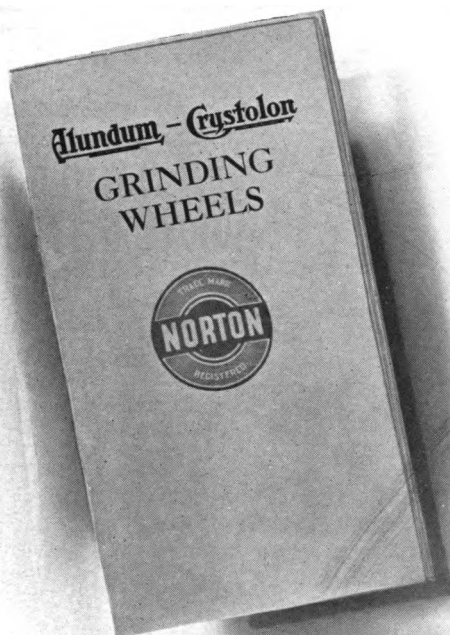
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August

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1911

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The above booklet contains many interesting facts about grinding wheels. It describes very briefly the grits used in Norton wheels, the process of manufacture, information about grain and grade, suggestions for ordering wheels, price list, etc.

It illustrates and describes the correct and wrong methods of mounting wheels, contains rules for obtaining surface speeds, rules for calculating speeds and diameters of pulleys, tables of speeds at which grinding wheels should be run, etc. It will be forwarded by Norton Company to anyone who requests it



## Automatic Grinding

**Evolution of the Automatic Grinding Machine from the Engine Lathe. Ball Bearings the First Field. The Automatic can be Applied to any Form of Chuck Work for Grinding External Diameters. One Operator for a Battery of Machines**

It may be interesting to mechanics to learn that cylindrical grinding has arrived at that stage of development that automatic grinding has appeared. Older mechanics will remember that all round work such as screws, studs, etc., were originally made on what was called the engine lathe. In the early 60's the turret lathe appeared, sometimes called the tur-

Cylindrical grinding was first done in a crude way on a lathe with the wheel mounted on a carriage. Later J. R. Brown, through the Brown & Sharpe Mfg. Co., introduced a cylindrical grinding machine. Since then, various types of grinding machines have been brought out, but until now there has been no full automatic grinding machine. This full automatic cylindrical grinding machine will do for grinding what the full automatic screw machine did for screws, studs, etc.

The Norton Grinding Co. recently brought out this automatic grinding machine and it has been put in operation by makers of ball bearings. In other words, that is the first field in the country for them. It is grinding external diameters of ball race rings. They are fed by gravity through a hopper and guide and chucked, ground to size, released from the chuck, and dropped on to an endless chain which conveys them to a receptacle, finished.

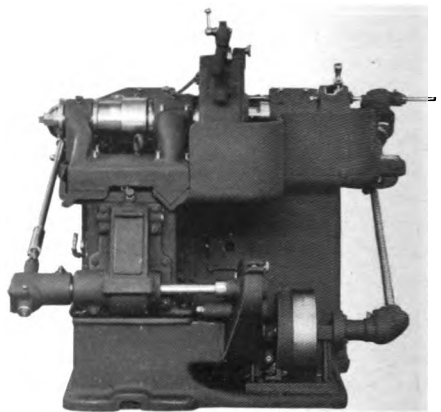


Side View 6" Automatic

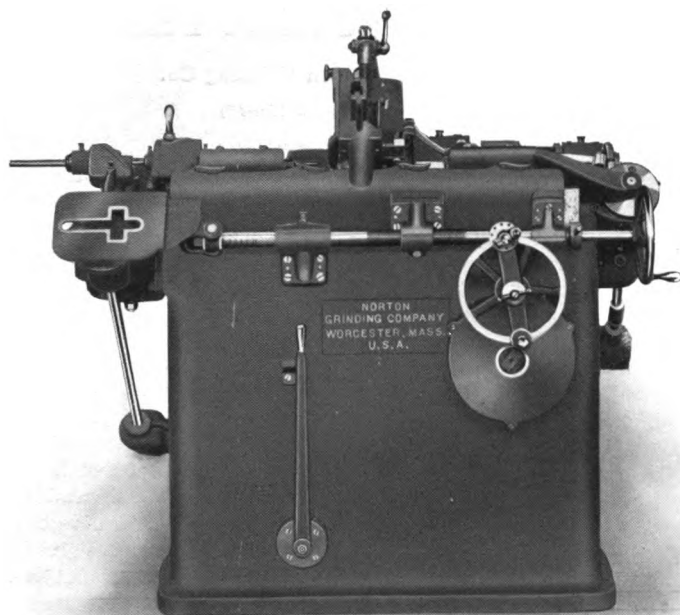
ret screw machine and at other times the monitor screw machine. These names were perfectly natural as at that time the famous Monitor, invented by Ericsson, had made such a grand fight against the Merrimac in the Civil War that it was much talked of.

Inasmuch as these machines produced screws, studs, etc., so much more rapidly than the engine lathe, it was a step toward the automatic although not automatic.

Then, in 1887, followed the full automatic screw machine invented and built by the Brown & Sharpe Mfg. Co.



Rear View 6" Automatic



Norton Automatic Grinding Machine

The new machine is capable of five or more cycles per minute and such rings can be ground at the rate of four or five per minute, according to size and quality of surface requirements. The roughing operation requires about four to the minute, while the finishing operation requires about five to the minute.

There are some novel features in the construction of these machines designed to affect the accuracy of the product and of the moving machine parts. While being used at the present time for grinding external diameters of ball race rings, they can be applied to any form of chuck work, that is, for grinding external diameters.

The machines can also be modified and made semi-automatic for grinding work on centers. The operator places the work on centers and starts the machine. The machine will grind work and when the work is completed, will stop automatically. This enables one operator

to attend to many machines and, it will be observed, will make it possible for those manufacturing large numbers of duplicate parts to control their output and not be dependent upon the operators in reference to feeds, speeds, depth of cut, etc., which so vitally affect production.

In regard to these new grinding machines the "American Machinist" has to say:

"The grinding machine has brought many surprises to the manufacturing world during the past decade. The latest development along this line is by the Norton Grinding Co., Worcester, Mass., in the shape of a machine which handles the work automatically in the same way as the screw machine with its magazine feed. In practice, there will be chutes leading to each magazine feed so that one man or boy can feed a battery of machines."

# Need of a Gage for Surface Finishing

By John C. Spence of Norton Grinning Co.

(Reprinted from "American Machinist")

When one person tells another that he would like a certain surface ground to a certain finish, he has no means of conveying a definite idea of the surface he wants. He uses such expressions as "fine finish," "commercial finish," "smooth finish," etc. Now, these terms have an entirely different meaning to different minds. It all depends on the previous training a particular mind has had. What is a "fine finish" in one business is only a "commercial finish" in another. For instance, "a commercial finish" in the manufacture of plug gages would be a "fine finish" in the machine tool business, and what is a "commercial finish" in the machine tool line the agricultural machine maker would believe to be a waste of time.

There are several methods of testing surface finish in vogue, at the present time. The most common is by eyesight, alone. This requires much experience, as a poorly ground, somewhat chattered, surface will look "fine" to the novice, especially if the surface has been produced by a hard, fine wheel, and consequently has a bright shine.

Another method is to clamp a piece of sheet lead onto the surface, if it be cylindrical, and, by rubbing with the lead, show the imperfections. This method has the doubtful merit of being cheap but is misleading; as lead, being soft and pliable, will follow the inaccuracies to a certain extent. Also, if the lead is traversed lengthwise of the cylinder, the inaccuracies of the lead surface will make marks on the ground surface that will appear to be chatters, when, in reality, there are no chatters.

The best test of a cylindrical surface, at present, is to lap with a tight fitting ring. This shows up the apparent imperfections, although these so called "mottles"

or "waves" often have such small depth, that no measurable (by ordinary micrometers) difference results when they are entirely lapped out and, so far as actual mechanical practice is concerned, a thing that cannot be measured does not exist.

It is to definitely settle these points that the need of a surface finish gauge is felt. We can put on paper our desires regarding the chemical and physical properties of a piece of metal. We can even arrive at a fairly indisputable understanding concerning so elusive a quality as hardness, but no one has given us the key to the surface finish problem. We can designate cloth by the threads per inch, speed by feet per second, electricity by voltage and current, but we have no surface finish unit. This subject will assume a greater importance as the demands for high speed increase as it is not at all certain that a highly polished "fine" surface is easiest to keep lubricated.

The discovery of a means of designating surface finish will do away with a whole lot of "old woman" decisions that, to-day, needlessly hold up production. There is a certain class of mechanics to whom the word "grind" seems to imply perfection and, therefore, any ground surface that shows imperfections, even under a microscope, is not good grinding. On the other hand, the mechanic who recognizes that there is a proper surface for each case in question just as there are proper diameter limits for each case, is the one who will reap the reward.

If the mechanical world had ever attained perfection in the production of surfaces, we would be wise to question the introduction of a new method and, if that method fell short of perfection, we would be warranted in condemning it. But, since the mission of the grinder is to

replace the fine feed lathe cut and the tedious file, we have simply to ask ourselves; "Is this an improvement over old methods?" If the answer is affirmative, let us be thankful for the fact that the world really progresses and, instead of being "from Missouri," let us all aim to hold the advantage we have gained, in cost of

production, and not be forced backwards by the chimera of "feed lines," "mottles" and other tricks of interfering light waves. If, in holding to this advantage, we can, at the same time, improve the surface, through skill, well and good; we will all rejoice.



## Alundum Grain Used for Refractory Purposes

**Coarse Grains Successfully Used in Vaporizing Tubes. High Thermal Conductivity an Additional Advantage. Wear on Mixing Tubes Reduced by the Use of Alundum**

ALUNDUM GRAIN is being used to good advantage in vaporizing tubes of burners using oil, as the high thermal conductivity does not make it necessary to heat the tubes to an extent so great as when gravel, quartz and other materials are used.

Those who have tested ALUNDUM for vaporizing purposes, report having found the very coarse grades of grain best suited for the purpose, and their best results have been from the use of numbers 4 and 6 mesh.

The operation of vaporizing with tubes supplied with ALUNDUM, consists of having the oil pass through one end of the vaporizing tube, while the heat is supplied on the outside. The oil, which is vaporized at 1,400 degrees Fahrenheit or lower, is then passed in vapor form, into an ordinary burner, and burned in the usual way.

Those who have tested out ALUNDUM for this purpose, report they have found it to be of great advantage to them. The advantage is all the more marked because

of the high thermal conductivity, inactivity and great density of ALUNDUM, which prevents the oil and carbonaceous residue from being absorbed by the grain.

One of the special advantages found in ALUNDUM has been in the fact that the vaporizing tubes need not be heated so high as when other materials are used. This has been found to lessen the wear and tear on mixing tubes, and increase their life considerably.

These vaporizing tubes are used on steam automobiles to cut the gasoline fuel into a vapor, before carrying it to main burners and fire pans to be consumed in making steam for power. One of the great troubles with steam automobiles is that the vaporizers are located immediately over the main burners, or fire pans, and the intense heat quickly burns them out.

In automobile burners, the oil, or gasoline, is blown through the vaporizers from compression storage tanks kept under from 40 to 60 pounds air pressure.

## Metallurgical Notes

Air hardening, with or without an air blast, is hardly applicable unless the object to be hardened is very small.

Air hardening or air quenched steel is a name given to the Tungsten high speed steels which are made sufficiently hard simply by cooling in air.

Air toughening is reheating the material to a yellow heat, and then cooling it in air.

Alloy steels are steels which owe their properties chiefly to the presence of an element or elements other than carbon.

Aluminum steels containing less than 3% of aluminum have the same properties of ordinary steels. Above this percentage they become quite brittle.

Annealing may (1) completely undo the effect of hardening; (2) remove any internal stresses set up by quick uneven cooling; (3) refine the grain.

Anti-fatigue metal is vanadium steel which has very great resistance to repeated shocks.

Anti-friction metal, used to reduce the friction of bearings, consists of various propositions of lead, tin, zinc and antimony.

Bar iron is wrought iron in the form of bars.

In the basic Bessemer steel nearly all the silicon, carbon, manganese, most of the phosphorous and some of the sulphur are eliminated by blowing air through the molten pig iron in the converters. The success of the process depends upon the lining of the converter.

Charcoal iron is pig iron which has been smelted with charcoal.

Black heart malleable iron derives its name from the fact that in annealing only

the outer layers of carbon are oxidized, the carbon of the interior being simply changed to a black amorphous state.

Blister steel is a highly carbonized wrought iron and is made by keeping wrought iron bars at a red heat for some days in contact with charcoal. The name comes from the fact that the surface of the iron is covered with small blisters, supposed to be due to the action of carbon upon the slag.

Fine wire and thin sheets are best annealed by pot or box annealing. In this way the material is protected from oxidation.

Although cobalt and nickel have very similar properties, cobalt steels do not resemble nickel steels in the least.

Copper in small quantities will increase the strength and toughness of steel.

The original Damascus steel, famed for the beautiful figurations, principally upon sword blades and gun barrels, contained tungsten, nickel, manganese, etc.

Fibrous iron, which is very rare, is a tough, soft, wrought iron and is neither cold nor red-short to a sensible degree.

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### "GRINDING WHEELS FOR THE SAW MILL"

This is a little pamphlet which should be of interest to users of saw gumming and knife sharpening wheels. It contains valuable suggestions in connection with the uses of wheels, the selection of grain and grade and speeds at which they should run. It also illustrates and gives dimensions and prices of wheels used on the leading knife grinding machines in use. It will be sent to anyone on request.

## Facts About Polishing

By W. F. Ford

**Kinds of Polishing Wheels—Wooden, Compressed, Canvas and Muslin, Sea Horse and Felt. Care of Polishing Wheels. Polishing Operations. Use of Alundum. Stove Polishing**

There are many varieties of polishing wheels in use, the principal kinds being known as wooden wheels, compressed wheels, canvas and muslin, sea horse and felt wheels. To equip a polishing room with the right wheels requires the assistance of a polisher, who has had a wide experience in polishing and is familiar with the various methods employed and the best abrasives. For good work, and economy in abrasive, glue and labor cost, wheels and methods must be selected to suit the work.

### WOODEN WHEELS

A few years back, the wooden wheel covered with leather and turned to fit the piece to be polished was universally used. At the present time, the wooden leather-covered wheel is used largely on flat surfaces and on work where it is necessary to maintain good edges. This style of wheel made with a double coat of leather makes a first-class finishing wheel.

### COMPRESSED WHEELS

Compressed wheels, or wheels having a steel centre, can be obtained made with a surface of leather, canvas or linen. Many tool shops are equipped with these wheels exclusively. They answer all purposes and are safer and more economical than the wooden wheel.

They are, also, used largely on cutlery and for polishing chilled plows.

The compressed wheel is durable, of strong construction and is easily kept in balance.

### CANVAS AND MUSLIN WHEELS

These wheels are extensively used for polishing stoves, shovels, plows (in many plants), brass, cast iron and steel.

For roughing out and dry fining on irregular pieces, they have proven very satisfactory. They hold the abrasive well and require no washing off. They are cleaned with a buff stick or a Crystolon brick.

Many concerns, such as plow, shovel and hoe manufacturers, buy the canvas and muslin and make their own wheels.

### SEA HORSE WHEELS

These wheels are very expensive. Most concerns using them buy the hides and make their own wheels.

Where a high grade polish is required, there is no wheel that can compare with a sea horse wheel. They are used largely on guns, pistols and cutlery.

### FELT WHEELS

These are made from white Spanish and Mexican felt and are used extensively for finishing on certain classes of work. Most stove concerns finish on felt or bull-neck wheels.

### CARE OF POLISHING WHEELS

Keep polishing wheels in perfect balance and running true at all times. A wheel out of balance wastes time, glue and abrasive and will not do as good work.

The most efficient glue and the best abrasive are the cheapest in the end.

See that the glue pots are kept clean, and the glue properly cooked.

Heating the abrasive is important.

Keep the wheels properly cleaned and properly covered with abrasive.

Select the wheels best adapted to your particular class of work.

Care in the selection of wheels, glue and abrasive means a saving in the cost of your polishing department, increased production and a better quality of work.

**ALUNDUM GRAIN FOR POLISHING**

In actual practice, Alundum has proven its superiority over all other abrasives in polishing on a great variety of work such as cutlery, stove parts, sad irons, axes, hammers, wrenches, forks, hoes, automobile parts, telephone parts, plows, shares, discs, drills, scales, adding machine parts, locks, guns, pistols, shovels, typewriter parts, carriage irons, barber chair parts, miners' tools, fireplace fronts, saws, steel forged tools, and on every polishing operation known on brass, aluminum and copper.

Where the conditions in the factory are favorable, from two to six times as many pieces have been turned out by using Alundum in place of other abrasives. In the manufacture of plows, plow shares, cutlery, tools and other classes of work where drawing of temper is detrimental to the work, Alundum cuts sharp, free and cool—thereby saving considerable breakage, and will not burn. By the use of Alundum, there is a big saving in labor cost.

When considering a change in abrasives, do not consider only the first cost of the

material, but the cost of labor, glue and wheels, the difference in production and the finish on the work.

**STOVE POLISHING**

Alundum has proven much more economical than any other abrasive for polishing stoves. This work is considered the most severe on polishing wheels. In many plants, the number of wheels used has been reduced from 50 to 100 per cent by using Alundum in place of other abrasives. Alundum gives the kind of finish required.

**POLISHING OPERATIONS**

Polishing operations are generally termed "Roughing," "Dry Fining" and "Finishing" or "Oiling."

Ordinarily for "Roughing" the numbers used run from 20 to 80. For "Dry Fining," from 90 to 120. The numbers used for "Finishing" are 150 to XF.

For "Roughing Out" and "Dry Fining," the polishing wheels are used "dry." For "Finishing," the wheels are first worn down a little, and then oil, beeswax, tallow, etc. are used on the wheel, with the abrasive, to bring up the finish.

# Norton Products

Alundum Grinding Wheels  
 Crystolon Grinding Wheels  
 Alundum Grain for Polishing  
 Crystolon Grain for Polishing  
 India Oil Stones  
 Crystolon Sharpening Stones  
 Glass Cutting Wheels

Razor Hones  
 Scythe Stones  
 Norton Alundum Refractories  
 Alundum Valve Grinding  
 Compound  
 Rubbing Bricks and Stones  
 Grinding Wheel Dressers  
 Grinding Machinery

## Norton Company, Worcester, Mass.

Alundum Plant, Niagara Falls, N. Y.  
 Crystolon Plant, Chippawa, Canada

New York Store, 151 Chambers Street  
 Chicago Store, 11 N. Jefferson Street

# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

1911

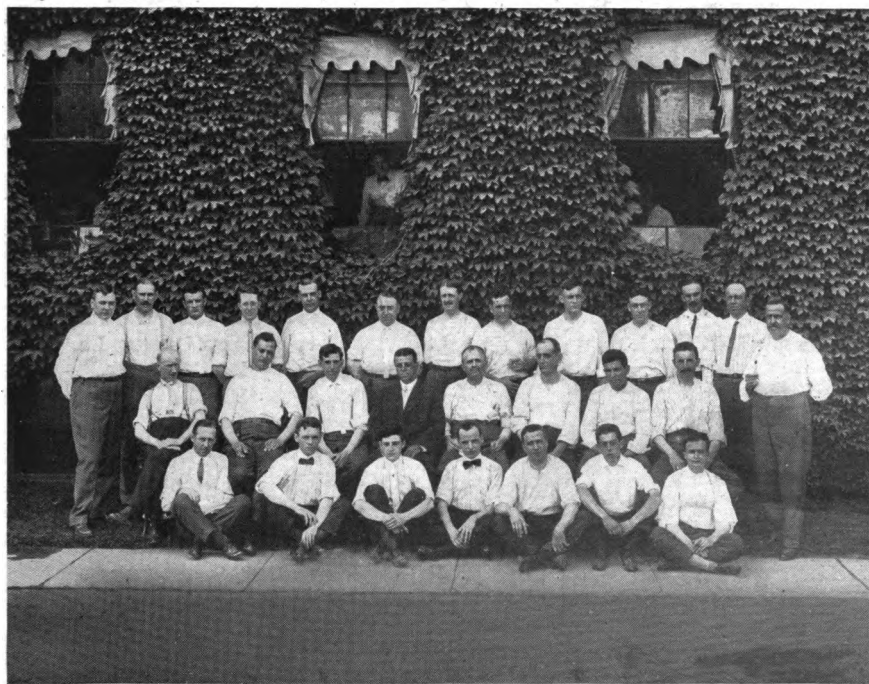
September

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1911

## SUMMER SCHOOL NUMBER

A Synopsis of a Special Course of Instruction in the Manufacture and  
Sale of Grinding Wheels Given at the Norton Plant



Students and Instructors at Norton Company's  
1911 Summer School



## Norton Summer School

The current issue of "Grits and Grinds" is devoted to an account of the special course of instruction, relating to Norton products, for salesmen connected with Norton agencies, as per list below.

The meetings were held in the lecture room of the Worcester plant during the week of July 10th-15th.

The objects sought were to acquaint our representatives with Norton methods of manufacture and experimentation, and to give them, so far as possible, the benefit of Norton experience in adaptation of Norton Alundum and Crystolon Grinding Wheels to the great variety of work which they are required to perform.

Although the temperature during nearly all the time was so high as to be almost unbearable, every one worked with a will, and attended all sessions promptly.

However, "all work and no play makes Jack a dull boy," and as shown by the snapshot reproductions the "grind" was more or less relieved by auto picnics, sails on Lake Quinsigamond, dinner at the "Tatassit," etc., so that we hope all present took away with them at least a few pleasant recollections, as well as considerable practical knowledge.

|                                  |                     |                    |
|----------------------------------|---------------------|--------------------|
| Canadian-Fairbanks Co., Ltd.,    | Lawrence Russell,   | Montreal, Canada   |
| Canadian-Fairbanks Co., Ltd.,    | J. E. Chipchase,    | Toronto, Canada.   |
| Chandler & Farquhar Co.,         | { William Fish,     | Boston, Mass.      |
|                                  | { Alfred Townsend,  | Boston, Mass.      |
| Chas. Churchill & Co., Ltd.,     | { D. M. Caird,      | London, England.   |
|                                  | { J. E. Livermore   | London, England.   |
| Cleveland Tool & Supply Co.,     | { W. W. Kelly,      | Cleveland, O.      |
|                                  | { J. C. Wright,     | Cleveland, O.      |
| Geller, Ward & Hasner Hdwe. Co., | B. E. Reed,         | St. Louis, Mo.     |
| National Supply Co.,             | { J. A. Gordon,     | Toledo, O.         |
|                                  | { J. G. McKee,      | Toledo, O.         |
| Norton Company,                  | Chas. H. Cutter,    | Chicago, Ill.      |
| Northwestern Pipe & Supply Co.,  | B. V. Selby,        | Erie, Pa.          |
| J. Jacob Shannon & Co.,          | { John A. Conboy,   | Philadelphia, Pa.  |
|                                  | { C. E. Peterson,   | Philadelphia, Pa.  |
| Simonds Mfg. Co., Ltd.,          | L. E. Bowman,       | New Orleans, La.   |
|                                  | { F. J. Wharton,    | Pittsburgh, Pa.    |
| Somers, Fitler & Todd Co.,       | { W. R. Johns,      | Pittsburgh, Pa.    |
|                                  | { G. Will Reynolds, | Syracuse, N. Y.    |
| Syracuse Supply Co.,             | { E. O. Ridings,    | Syracuse, N. Y.    |
| Vonnegut Hdwe. Co.,              | C. A. Grumann,      | Indianapolis, Ind. |
| Walbridge & Co.,                 | Carter B. Oliver,   | Buffalo, N. Y.     |
| J. T. Wing & Co.,                | H. Stahl,           | Detroit, Mich.     |

### "SALESMEN DOWN TO WORK"

It was some "grind" for the twenty-three salesmen who spent the week with us.

Gee! wasn't it hot! Old Sol made things sizzle. And the gritty professors

of wheelology kept them "warmed up" to the subject every minute.

It was a school in every sense of the word—where the roll was called at 9.30 A. M. and the whistle blew at 5.00 P. M., where illustrated lectures, manufacturing

demonstrations and heart to heart talks were every day happenings.

It gave these men who sell grinding wheels an insight into their manufacture and use. Some of them perhaps had only heard and read about grit and bond, grain grade, bushing, dressing, truing, and a lot of other shoppy terms that belong to the grinding wheel business. But the Summer School gave them an opportunity to get in close touch with these things—to take off their coats and follow the grit and bond through the many steps of refining and preparation for use, to learn what grain and grade actually mean and to bush a wheel, dress it, true it.

We all know that a thorough knowledge of the thing that you are selling—how it is made, how it works—is the biggest factor in selling it.

One cannot fully appreciate Norton quality until a visit is made to the Worcester grinding wheel works where he can see with what care per detail grinding wheels are made here. In the laboratories where tests are made daily, he learns that the materials that go into Norton wheels must be up to a high standard. He learns in the Department of Tests the reason why different metals and different conditions require wheels of different grain and grade and that there is a Norton wheel adapted to every kind of grinding. He sees here how the lasting and enduring qualities of wheels are tested and learns that this department is of value to customers and salesmen in the matter of selecting the right wheel. Following the manufacture of the wheels he is sure to be impressed with the care in the preparation of the cutting materials, in the mixing, truing, bushing, grading, testing, inspecting and packing for shipment—thoroughness in every department.

The Norton plant is open at all times to men who are interested in selling Norton Grinding Wheels.

To say that the Summer School was a success was speaking of it in a mild way. Every man who attended is surely a better grinding wheel salesman than he was before he came.

## ILLUSTRATED TALK ON ABRASIVES

As a fitting opening of the Summer School Course, the first half day was devoted to an inspection trip through the grinding wheel plant of Norton Company and the grinding machine plant of Norton Grinding Company.

They were then made thoroughly acquainted with the kinds of abrasives used in the manufacture of wheels and their production by an illustrated talk delivered by A. C. Higgins, manager of the Norton Company Abrasive Plants. His talk gave a brief history of natural abrasives and their use, and the evolution of the modern artificial abrasives which have been responsible, to a large extent, in the rapid development of the broad field for grinding.

By means of lantern slides, he took the men present not only through the various operations of manufacturing both Alundum and Crystolon but even through an inspection tour of the mines where the mineral Bauxite, used in the manufacture of Alundum, is obtained.

By illustrations of microphotographs some of the characteristics of these different abrasives were plainly shown. He pointed out the differences in quality of the natural minerals obtainable and the manufactured abrasives; also, that it is possible to produce the manufactured grits in uniform quality, which is a big factor in the production of grinding wheels of uniform quality.

With this introduction to the abrasive materials used by Norton Company and the products made by them, the salesmen were in position to better understand the lectures, talks and demonstrations which were to follow.

## BUSHING—MOUNTING—TRUING BALANCING

Among the many interesting subjects taken up during the course of instruction was one on bushing, mounting, truing and balancing grinding wheels. Assistant Superintendent George N. Jeppson of Norton

Company, gave a talk on these subjects pointing out the fact that serious accidents sometimes happen through the methods of re-bushing and blottering wheels by dealers and users. In his talk he explained the correct methods of bushing and blottering and why accidents are liable to happen because of the incorrect methods in use.

The various methods of mounting grinding wheels were described in detail. The most common method is to mount the wheel on a spindle between two flanges one fixed on the spindle and both properly relieved.

The objections to the use of iron backs on which the wheel is cemented was pointed out by Mr. Jeppson. This type of mounting is not accepted as good and should be avoided. Clamp flanges can nearly always be designed to take the place of fixed centers.

Other subjects talked on under this heading were collets or tapered sockets, chucks, wheels with large holes, truing and balancing.

Unrestricted use of dressers and cutters is often the cause of noticeable discrepancies in individual wheel earnings in a lot of wheels made and shipped at the same time. Reports are frequently received that a 20-U wheel, for instance, wears out sooner than a 20-R which is due to the fact that the harder wheel has been worn out by the dresser because it probably glazes or loads more often than the softer one.

The salesmen present were advised on many points of this kind which space will not allow us to go into detail here. These talks will be published in more complete form in later issues of "Grits and Grinds."

After this talk, the students were given a practical demonstration in bushing, mounting, truing and balancing wheels. They had an opportunity to spend an hour or two in each of these different departments actually doing the work.

#### SAFETY AS APPLIED TO GRINDING WHEELS

The salesmen present were not only instructed in connection with the manufacture and sale of wheels, but particular

emphasis was placed on the protection of labor in the use of grinding wheels.

Mr. Williams, of the Norton Company Department of Tests, illustrated with lantern slides the many practical safety devices in use, the different methods of mounting wheels, etc.—calling especial attention to the factors that influence safety and the factors to which experience and investigations attribute the cause of accidents. His talk covered the subjects of speeds at which wheels should run, speed changing devices, devices for limiting speeds of wheels and for preventing the use of over-size wheels on certain machines, methods of testing wheels in the factory, the installation of dust systems in connection with grinding machines of various types and the points to bear in mind when investigating grinding wheel accidents.

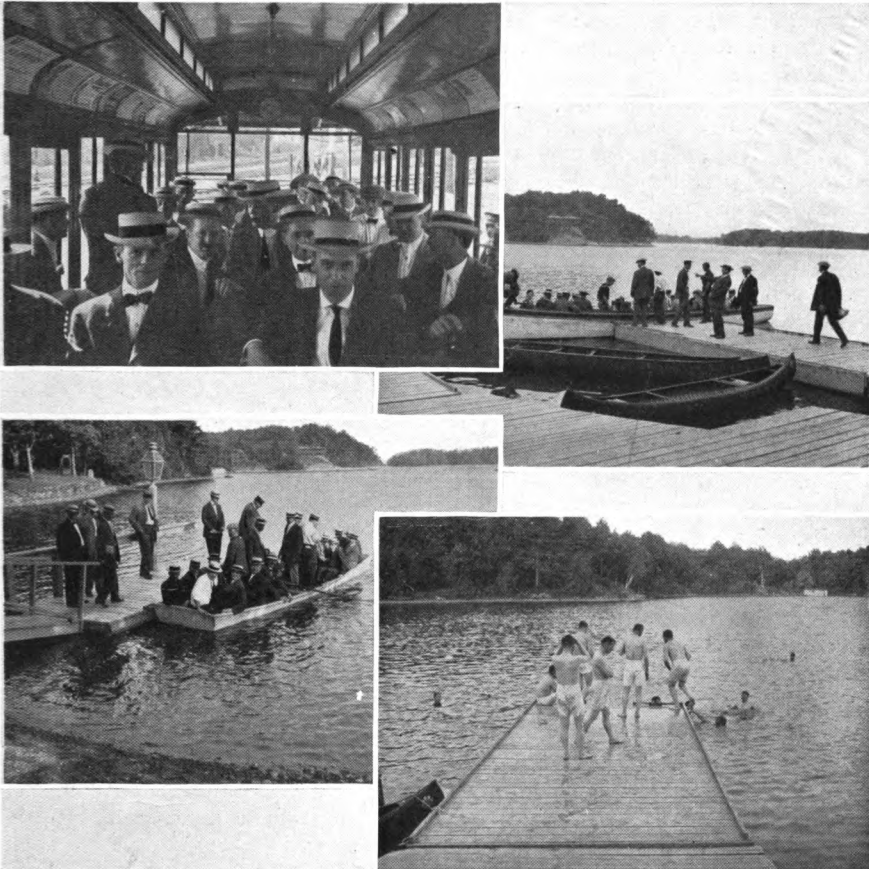
#### GRAIN AND GRADE—WHAT DETERMINES THEIR SELECTION

Perhaps the most valuable of all talks to the salesmen was the one on "Grain and Grade—what determines their selection?" by Mr. Jeppson. It was thoroughly explained just what is meant by grain and grade, and why coarse grain is used in wheels for certain purposes and fine grain for others. Generally speaking, grits from 10 to 30 are used on all heavy work such as rough grinding of steel and cast iron castings, and the medium grits, 36 to 80, for nearly all tool grinding, saw gumming and operations where precision in measurement is sought. The finer grains 90 and above, are used for special work such as grinding balls, fine edge work, cutlery, etc. The flours are used for oil stones, glass wheels, razor hones, etc.

The determining factors when selecting the grain and grade for the work are: Machine—speed of spindle, speed of work, condition of repair, wet or dry grinding, proper safety devices.

Work—weight of piece, the amount of material finished, required dimensions.

Contact—broad or narrow.



There was Something Doing After School

These subjects were taken up in detail as they relate to the selection of the wheel.

Each salesman must make it a point to learn all the details in connection with the grinding operation and send the information to the factory, if he wishes to give his customer the best service obtainable.

### SELLING ARGUMENTS

The session devoted to the selling of grinding wheels was in charge of Norton Company's sales manager, E. W. Dodge. This session was given up chiefly to questions and answers and discussion of various topics in connection with selling,

many of which would be of interest to the readers of "Grits and Grinds" if we had the space to publish them in detail.

The important points emphasized were:

Two distinct kinds of abrasives radically different in chemical composition, also in structure and in character of fracture.

With both Alundum and Crystolon in their different forms, we can meet every grinding requirement.

Alundum is especially adapted to grinding every kind of steel and other materials of high tensile strength.

Crystolon, on account of its characteristics of brittleness and sharpness, is

adapted to grinding cast iron, bronze, brass, pearl, marble, granite and like materials of low tensile strength.

The experience and success of the Norton Company in the matter of duplicating grades is a good talking point.

Many other subjects were considered which are of interest only to salesmen and the sales department, and the relation of agents to the sales department.

to give here only a very brief synopsis of the points brought out.

Iron and steel were considered in their different compositions.

The properties which influence the selection of a wheel for any given operation are tensile strength, elastic limit, hardness, brittleness, toughness, malleability and ductility.

Mr. Williams explained thoroughly the



"The Automobile Ride"

## MATERIALS THAT ARE GROUND

This subject was handled by R. G. Williams of the Norton Company's Department of Tests.

At the outset he called attention to the fact that it would be difficult to mention a manufactured article where the grinding wheel has not in some stage of its process assisted to a certain extent in its manufacture. This subject was interestingly and thoroughly discussed and we will attempt

relation of carbon to iron and pointed out that the percentage of carbon determines to a large extent the grade of steel.

The characteristics of wrought iron, gray iron, chilled iron and malleable iron were taken up in detail. Also, the subjects of case-hardening, special steels, monel metal, etc. Particular emphasis was placed on the properties of these various metals as they relate to the selection of a grinding wheel for grinding them.

Supplementing this talk on metals and to show the efficiency of wheels of different grain and grade on various metals, demonstrations were given in the Department of Tests of Norton Company's laboratories.

### CLYINDRICAL GRINDING

This was the subject of a talk given by C. H. Norton of Norton Grinding Company. While this talk was of a general nature and very interesting to any one using or selling grinding wheels, the explanation of the causes of chatter marks, feed lines and other grinding troubles, and the remedies suggested were of exceptional value.

The combination of coarse, rough lathe turning and finishing on the grinding machine should be adopted in order to reach maximum economy. The cylindrical grinding machine of the Norton type, when the right methods are used, effects a remarkable saving in the turning department. Very frequently manufacturers fail to make the best of their opportunities to economize because of the long practice of doing nice turning. Many foremen do not appreciate the fact that a grinding

wheel will finish a piece of work that was turned on a heavy lathe taking a deep cut as quickly and perhaps quicker than if the piece was carefully turned by taking fine cuts and a longer time to do it. In other words, the ideal method in most instances is to turn to grinding size in roughing lathes, using coarse feeds, and finish on the grinding machine.

Mr. Norton touched on many other points such as speed of machine, speed of work, contact between the wheel and work, finishes required, grain and grade of wheel desired for cylindrical grinding, kinds of finishes obtained with wheels of different degrees of coarseness, kind of wheel required for fine finish and coarse finish, etc.

### RE-BALANCING OF WHEELS

J. C. Spence, superintendent of Norton Grinding Company, talking on the above subject, deeply impressed on the minds of his hearers that in order to get first-class results in cylindrical grinding and in fact any kind of grinding, the entire revolving mass made up of the spindle, spindle pulley, wheel sleeve and wheel must be in running balance. He pointed to the fact that every wheel made in the



Lake Quinsigamond Contributed a Breeze

world is subject to an unequal distribution of material and that while scientific thought and care keep Norton wheels as well balanced as can be expected, it is necessary sometimes to put them in perfect balance with the use of a lead counter balance.

By illustration, he showed why such a wheel is liable to be out of balance when reduced to a smaller diameter. The necessity of keeping wheels in balance at all times, and the best methods of balancing and best devices to be used were taken up and explained.

### WORK OF LABORATORY

The work of the various departments of the Norton Company's laboratories, such as Ceramic Department, Analytical Laboratory, Abrasive Testing Department, Mechanical and Microscopic Laboratories was described in detail by P. A. Boeck. The efficient system of making tests and reporting back to the experimental com-

mittee and the co-operation and concerted action between the different departments is sure to result to the advantage of the company, as well as the agents and users of Norton wheels.

The methods of testing crude materials that enter into the manufacture of Norton Grinding Wheels, insuring uniformity, were described by Mr. Boeck. He pointed out the necessity of high quality and uniformity of raw materials, and that it is the duty of the laboratory to check a number of factory operations wherever it is possible in order to maintain a high quality.

His description of the many laboratory departments and detailed account of their duties—the elaborate, systematic and scientific methods used by this company to insure highest quality, and experimental research work—would naturally make a good impression on the men who are engaged at least part of the time in telling manufacturers about Norton wheels.

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## Grinding Wheels—The Field for their Use

Excerpts from a Talk to Summer School Students by G. N. Jeppson

The proper application of the grinding wheel makes our business an intensely interesting one. There is hardly a material we do not come in contact with and there is no industry that you go into wherein abrasive products are not used in some form. When you become enthusiastic and get the grinding microscope firmly established, you will see grinding possibilities in about everything that comes within the range of your vision; for instance, you will awake in the morning, look at your watch and for an inspiration remember that the oilstone and grinding wheel made its accurate timekeeping possible. You will walk into your bathroom and find that the floor and marble walls were made true by the grinding wheel, the tub was smoothed, whether it be of metal or porcelain, the fixtures

were snagged and polished, the incandescent lamps and their shades were ground, and that the water you will use passes through valves which have come in contact with abrasives. The mirror in which you will attempt to see whether the night before left an impression was beveled and smoothed and the window of plate glass was polished with abrasives. You will sit down at the breakfast table and find that the glass tumbler, porcelain and cutlery were all ground at some stage of their manufacture. The flour which made the bread was produced by means of accurately ground rolls, the centrifugal for separating the cream, the churn that made the butter and the stove that cooked the meal have all been in contact with the grinding wheel.

# GRITS AND GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

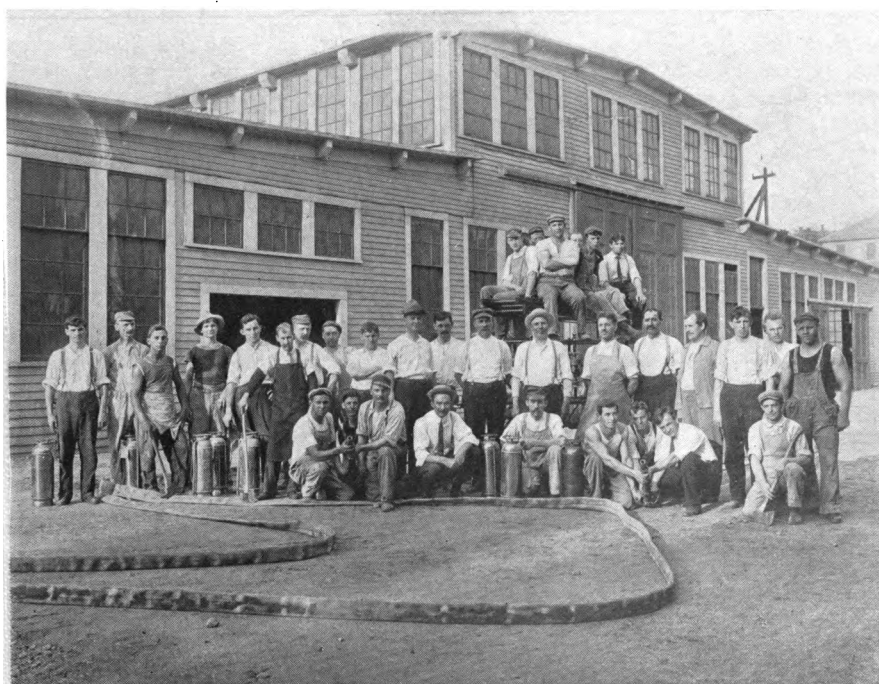
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1911

October

1911

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Norton Fire Department



# GRITS AND GRINDS

Vol. III

October, 1911

No. 6

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## Norton Fire Protection

**Sprinkler Systems—Efficient Fire Department—Fire Fighting Equipment  
Water Service—Alarm System—Regular Fire Drills—Quick Service  
When in Action—Co-operation with City Fire Department**

Believing it to be one of the duties of a manufacturer to take every possible precaution to make certain a continued output, Norton Co. and Norton Grinding Co. have organized fire departments equipped and trained to a point where they compare favorably with city fire departments.

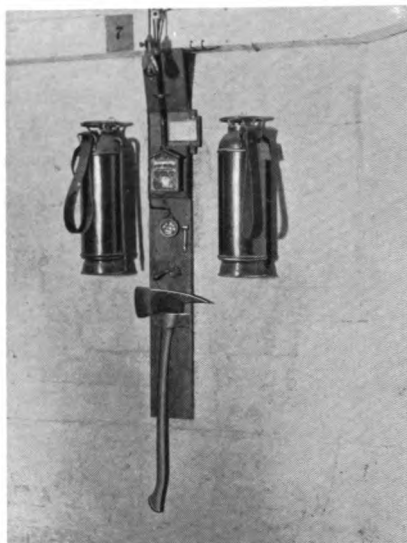
In addition, the entire works have been equipped with sprinkler systems of the most effectual types, and the opinions of experts, given at various times, are that it would take an unusual fire to burn in the face of the sprinklers and the Norton fire brigades.

The Norton fire department is composed entirely of picked men all of whom live near the works, and who are ready to jump to the call of duty night or day, Sundays and holidays. These men have been trained to quick work. Frequent tests have shown they are not only able to lay lines of water hose into buildings with all the speed of trained firemen, but that the chemical corps is efficient in having enough chemical on hand within a few seconds of an alarm to drown any ordinary fire.

The fire department equipment consists of one hand-drawn hose reel, equipped with 600 feet of 2½" water hose, a 25-foot ladder, and a full quota of lanterns which are kept lighted at night, the same as on city fire departments, and ready for immediate service. There are also many three-gallon hand chemicals, which contain more of the fire squelching gases than

the tanks of horse-drawn chemical fire engines.

All through the works, auxiliary boxes to the city fire alarm have been installed. In addition there are eight stations for the Norton Co. private alarm, and the Norton Grinding Co. have three of these stations. The breaking of a small glass is sufficient to sound the private alarm, but the auxiliaries to the city alarm must be pulled in the same manner as the street boxes.



One of the Auxiliary Fire Alarm Stations  
in Norton Plant



Norton Fire Department in Action

Every alarm station on the Norton private system has been made a clustering place for fire-fighting tools. Close beside each station are two hand chemicals, an axe and other things that may come in handy to the one who discovers a fire and sounds an alarm. The man discovering a fire may first break the glass with a small tapper suspended from a leash, then with his call for assistance registered, he may arm himself with an axe and chemicals without further delay.

The breaking of a glass on the private alarm system registers the box upon an annunciator in the boiler room. The box is blown on the works whistle, and at the same time, a bell call is sent to nearby stations of the city fire department, but a short distance from the main entrance to the works.

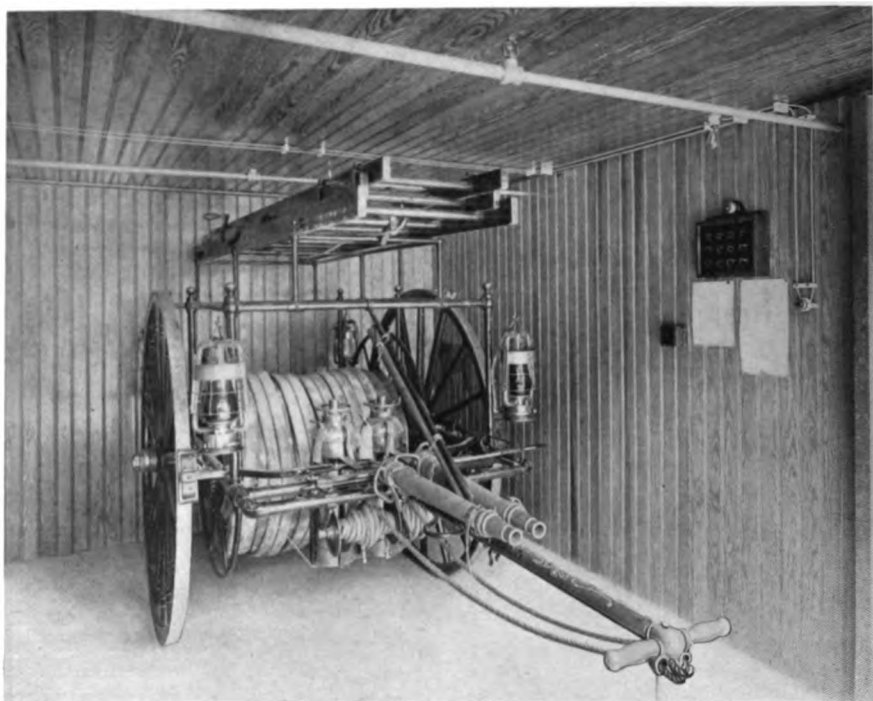
Should a fire prove to have too great a headway for the Norton firemen and those of the nearby fire stations, a city alarm may be registered by pulling any auxiliary box, and assistance called while the firemen already on the scene are fighting the blaze.

In cases where water or chemicals are poured into buildings, a salvage corps has

been provided to work at cleaning up and salvaging goods, that water may not be permitted to do more damage than fire. The salvage corps has been trained to save stock, order blanks, book folders, and every little thing of value aside from cleaning out the water immediately after a fire, that it may not leak down on the stock and materials on floors beneath.

The fire department has good water pressure to work with. The high-pressure four-way hydrants, distributed liberally about the yards of the Norton works, have tested pressure of from 120 to 130 pounds to the square inch, a pressure that would do credit to a small steam fire engine.

Sketches have been made of the location of every hydrant and water cock, every standpipe, and the Norton firemen have studied them diligently, until they are familiar with every station. In recent tests they have pulled their hose wagons from its station, hustled it to the nearest hydrant to the box from which the alarm registered, made connections, and had a water line laid into the building supposed to be burning, in  $1\frac{1}{2}$  minutes, then returned to the hydrant and laid a second



Hose Reel in Fire Station at Norton Company Plant

line in  $3\frac{1}{4}$  minutes from the first stroke of the alarm.

Taking into consideration that part of the haul of the hose-cart was over a railroad trestle, where the city fire department wagons could not go at all, the private firemen's work was satisfactory, and probably beat out the city department, starting from its house on the alarm, by eight or ten minutes.

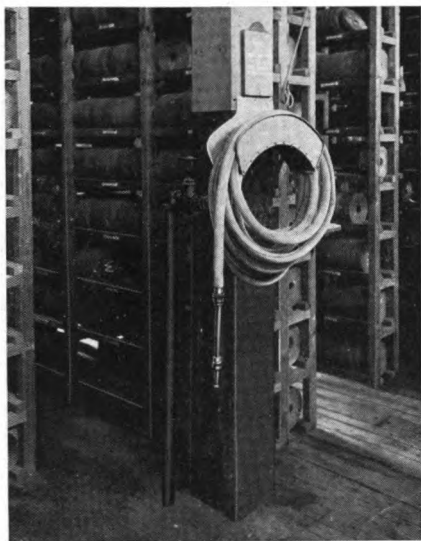
In addition to the general automatic sprinkler service, the works are equipped with standpipes, to which two inch hose is attached, with nozzle already for the inside hose crew. These standpipes are attached to high pressure water service. The power house has additional protection from fire which might be caused by sparks, inasmuch as its roof is piped in a way that makes it possible to flood it with water instantly in case of fire.

The roster of the Norton Fire Depart-

ment is: chief, deputy-chief, 1st and 2nd assistant chiefs, the outside hose corps which is composed of a captain, two lieutenants and 16 men; the inside hose and salvage corps, composed of two captains, one for water hose squad, and one for the hand chemical and salvage corps, and a lieutenant for each. The inside hose corps has, aside from its officers, seven men, while the hand chemical and salvage corps has nine aside from officers.

On a recent morning in midst of the hardest thunder and lightning storm of the year, a watchman discovered smoke in the kiln department, investigated, found a fire and sent in an alarm. The watchmen have been instructed to pull an alarm first, then go back and fight until assistance arrives.

Although it was some time before daylight, and workmen not due at the works



**Hose Racks Like the Above are Conspicuously Located in Convenient Places throughout the Norton Plant**

for two hours or more, a captain and 10 men braved the rain, thunder and lightning, to respond to the shop whistle on a fire call. The city apparatus, called on thermostat alarm, went astray not being familiar with the shop geography. But the Norton firemen plunged into the thick of it, nipped the fire in its budding, and the salvage corps men were getting in their work by the time the city fire department came clanging up to the scene.

The good work of the Norton firemen, the interest and loyalty shown by leaving beds and braving a rain at 5 o'clock in the morning to fight fire, was taken up by the directors the following day, and it was decided to pay each Norton fireman responding to all alarms outside of working hours for his trouble. At a recent alarm on Sunday afternoon, 23 Norton Co. firemen responded, and 11 firemen from the 18 men comprising the department of the Norton Grinding Co.

The hose reel has been placed in a fire station especially fitted up for it, at the

south end of Plant 3, a central location, and an annunciator box has been installed so that firemen who could not catch the box from the whistle, may find it shown upon the wall, by the time they arrive for the apparatus.

An advantage of having a shop fire department all primed and ready for action is that the men are acquainted with shop geography, whereas the city firemen have but slight acquaintance with it. In case of a big fire, the city firemen would find the Norton firemen valuable as guides as well as able aids in fire fighting.

### VALUE OF BLOTTERS

Compressible washers of pulp or rubber between the grinding wheel and flanges are safety appliances if properly used. They distribute the pressure evenly when the flanges are tightened by taking up any imperfections in wheel or flanges. Sometimes, however, these blotters are carelessly glued on by either the manufacturer or agent, distributing the glue unevenly. Glue in one spot will sometimes cause a wheel that is in perfect truth on its side to "run out."

Sawdust, in which wheels are packed, sometimes works under the blotters if they are not properly glued on, producing the same results as uneven distribution of glue.

### NEW GRINDING DEVICES

The recent issues of the trade papers illustrate and describe the following new grinding devices:

An attachment for grinding planer cutters built by Newton Machine Tool Works, Inc., Philadelphia, Pa. The attachment can be furnished for any style or shape of machine and employs grinding wheels of the shape desired.

24" Cutter Grinder by Ingersoll Milling Machine Co., Rockford, Ill. Wheel used 10 x 1½ x 1".

## Grinding Wheels that Cut

**Their Manufacture—Alundum and Crystolon the Abrasives Used—Necessity for the Use of Abrasives that Differ in "Temper." Special Norton Wheels for each Class of Work. When to Use Alundum Wheels and when Crystolon Wheels**

Excerpts from a talk by G. N. Jeppson at Norton Company's Summer School for Salesmen

To return to our subject—the manufacture of the cutting wheel. Wheels made from Alundum and Crystolon *cut* as will be proven to you in our mechanical laboratory. A cutting wheel is composed of abrasives which forms its cutting teeth, and bond, which cements the cutting particles together. The toughness and hardness of these cutting points are naturally of the greatest importance in securing efficiency. We control and make our own abrasives and have developed them to meet the requirements of a long experience in the manufacture and use of wheels, having in the early stages of our history used all the natural abrasives including emery and corundum.

Alundum is an abrasive that can be made in different tempers. By temper I mean "degree of hardness." This is important because it is well to remember that no one abrasive is best for the grinding of all metals. If the abrasive is too tough on a hard metal, like high carbon steel, it will dull rapidly, and if the bond is strong enough to hold it, the dull cutting points create heat and the work is burned. For work of this kind, we therefore require an abrasive of a different temper, whose cutting points break or shatter in pulling through the cut. This means that the cutting face of the wheel remains sharp longer, and we grind these hard metals more successfully. This temper, however, will not do on the tougher soft steel castings. Here we use a material of different temper—one that has sufficient toughness, so that we can use coarse wheels, take deep cuts and remove large chips without dulling the grain or breaking it off within a reasonable time.

Then again, we have for cast iron, brass and other materials of low tensile strength, Crystolon—a special abrasive, very brittle and hard—which is just tough enough to cut these comparatively soft materials without breaking off and which on account of its hardness, remains sharp longer than any other abrasive on this work. This material is of no use on steel, as it is not tough enough to pull through the cut. Immediately on coming in contact with steel, the cutting points on the grinding surface are wiped off, and we are then down to the bond and have an inefficient wheel.

From what I have said on abrasives, you will conclude that Norton wheels are made from special materials, each one suited for the class of work the wheel is intended for. The source of supply is assured and its quality under control.

To summarize:—

We use Alundum in its different tempers for carbon and alloy steels and use Crystolon for cast iron, chilled iron and brass. This is a general statement, but there are a few exceptions to this rule. It is interesting here to note that of the pig iron production of the world, about 75% goes into steel and the remainder into cast iron, so that the field for the Alundum wheels is vastly greater than that of Crystolon.

The bonding of these abrasives is of the greatest importance in making efficient cutting wheels. The function of the bond is to hold the cutting points until they have begun to dull. At this point the bond should release the dull grains and automatically present new ones, thus keeping the wheel sharp. If the bond

releases the cutting points too rapidly, we call the wheel too soft; if it holds them too long, we call the wheel too hard and it is not an economical grinding wheel in either case. It is, therefore, important that the

wheel maker has complete information on the kind of work and the conditions of the grinding in order that the proper grain and grade may be furnished.

## Metallography

**Some Interesting Facts that have been Learned Through Scientific Study of Metals, Many of which Must be Taken Into Consideration with Other Conditions when Selecting Wheels that Will Grind them Successfully**

Nickel steel is very unsatisfactory in forging operations, being very sticky and gummy. It causes considerable trouble by sticking to the dies.

Titanium purges steel castings from weakening gases and solid impurities. It also increases the strength of nickel and chrome nickel steels.

Chrome steel when in the hardened or suddenly cooled state, combines intense hardness with a high elastic limit so that it is neither deformed permanently nor cracked by extremely violent shocks.

Manganese steel is a striking exception to many other metals and alloys, from the fact that it may be both hard and ductile. Its hardness cannot be reduced to any great extent by annealing.

Tungsten steel is used in permanent magnets, because of its high retentivity.

Molybdenum steels have somewhat similar properties as tungsten steels except that 1% of molybdenum is equivalent to 2% of tungsten.

Tin will not readily oxidize at ordinary temperatures. It combines in all proportions with iron, but the alloy cannot be forged.

Carbon in cast iron is principally in two forms, combined carbon and graphitic carbon. The first affects the strength and hardness, while the second affects the softness and fluidity. Thinner castings contain more combined carbon while thicker castings have more graphitic.

Gun metal as used in the olden times for making cannon was cold-blast charcoal-iron remelted in an air furnace. It was a purer and better form of cast iron. To-day, we consider gun metal as a copper-zinc-tin alloy.

Sulphur makes iron brittle when hot while phosphorous has an opposite effect, making iron brittle when cold.

A wrought iron weld is much stronger than a steel weld.

Wrought iron presents a better surface for galvanizing than steel, hence the former will wear a much longer time.

Cast steel is crucible or blister steel cast into ingots. At one time this was called tool steel. To-day the name tool steel means nothing.

The strength of steel varies according to the points of carbon, maximum strength coming at about 100 points.

Soft steel, no matter how low in carbon, will harden to a certain extent upon being heated red-hot and plunged into water. It will harden more when plunged into brine and less when quenched in oil.

Shrinkage in steel is about 50% greater than in cast iron.

Phosphor-bronze makes one of the strongest forms of castings. The phosphorous acting as a deoxidizer purifies the metal thus giving a better form of bronze.

While copper in small amounts will close the grains of cast iron, it does not appreciably cause brittleness.

The strength of cast iron depends upon many other things than its chemical composition. Among them are the size and shape of the casting, the temperature at which the metal is poured and the rate of cooling.

Hard cast iron will shrink double the amount of gray iron. In annealing about half of this can be recovered, hence the net result is practically the same as in ordinary practice.

The chief characteristic of malleable iron over gray iron is its ability to resist shocks.

When wrought iron breaks, a crystalline structure is generally seen in place of a fibrous.

The higher the tensile strength of iron, the more vibrations it will stand, for it is not so easily strained beyond the elastic limit.

Cast iron, so inferior in strength to the steels at atmospheric temperatures, has under the higher temperatures nearly the same strength that the high-temperature steels then have.

During the process of reducing steel from ingots to the round bar, with successive heatings the carbon in the outside of the bar is burned out. The difference between the center and the outside may be as high as a .23%.

Manganese is very hard in its resistance to abrasion, but it is not always hard in its resistance to impact.

### INDIA OIL STONES IN THE PRINTING PLANT

An India Oil Stone has even cut its way into printing plants. The head machinist of the "Denver Post" calls attention to the value of the India Stone for touching up old linotype moulds—old moulds that were discarded as worthless before they began to use an India stone. After touching up, they give excellent results and work as smoothly as new moulds. No. 1½ India Combination Stone is used on the face of the mould and a small, round India file on the grooves.

In addition to the above use in the printing plant, the combination stone is used largely by pressmen in large newspaper offices for sharpening paper cutters. The cutters can be sharpened while the press is in motion. Before the efficiency of the India stone for this work was learned by the pressmen, it was necessary to remove the knives and have them ground at a machine shop, the cost of each grinding being approximately the same as the cost of one oil stone.

### ONE WAY TO SQUARE ACCOUNTS

TEXAS, July 24, 1911.

Gentlemen:—

"The grinding wheel ordered from you was received through the post office here Saturday the 22nd broken in four pieces.

"From the care with which the wheel was packed I should not have expected it to be broken and want to know if you ever had them broken in the mail. The postmaster he is about the meanest man I ever heard of and is making the patrons of the office all kinds of trouble, and on the 21st inst. forbearance ceased to be a "virtue," and I took the man in hand and knocked him down and kicked him, so it may be that the man deliberately stamped on this package in way of being revenged."

A Norton Grinding Wheel used on a modern machine by an operator with a good knowledge of grinding is just as surely a milling cutter as if it were made of steel. Its cutting surface consists of millions of small sharp cutting teeth and each tool that comes in contact with the work cuts off a chip in the same manner as the tooth of a milling cutter.

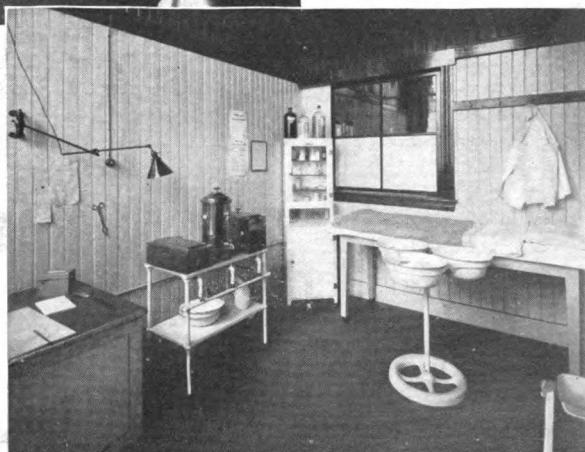
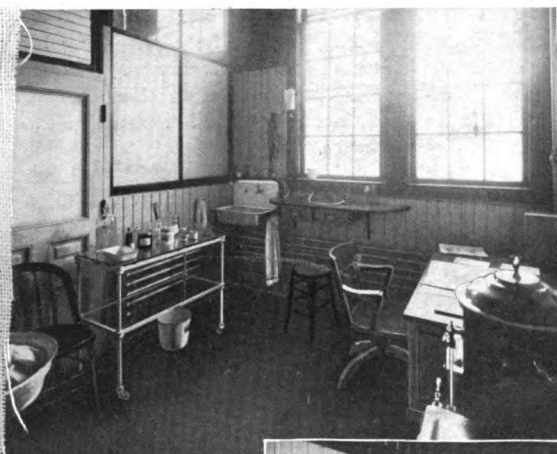
You can appreciate, therefore, the importance of using wheels made of modern "grit" or cutting material. Grinding wheels made of different grit will give different results just as tools made of different steels will give different results.

# GRITS and GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

NOVEMBER

1911



Factory Hospital Connected with Norton Company's Medical Department



# GRITS AND GRINDS

Vol. III

November, 1911

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## SHOP HYGIENE

More or less attention has always been given to sanitation, safety and comfort of workmen in the Norton plants. A spacious dining, reading and smoking room, sanitary washrooms and other conditions that guard against contagion and infection are maintained. Protection devices guard dangerous machines, belts, elevators and other points of danger throughout the plant. Dinners, outings and all functions that tend toward closer and pleasanter relations between shop and office are heartily encouraged.

Acting still further on the idea that what is good for employee is good for the employer, a Medical Department was established on May 1st, of this year in charge of Dr. W. Irving Clark. A factory hospital, equipped with the most modern apparatus, is maintained and a thorough system has been established for rendering first aid in case of accident, giving medical attention to men taken sick while at work and for building up a healthy working organization.

This company was among the first manufacturing firms to take up the fight against contagion, infection and tuberculosis in an organized and systematic manner.

We believe Norton employees fully appreciate the value of the Medical Department to them which has established increased interest and confidence between the men and the company.

The splendid spirit with which the men have co-operated with the management in the matter is indicated by the fact that out of more than six hundred, only one

has refused to have a thorough physical examination and many have specially requested it.

This issue of "Grits and Grinds" contains a detailed account by Dr. Clark of the plans and functions of the Medical Department and a summary of the result after six months' trial, which we hope will be interesting and instructive to our readers.

## VISIT THE NORTON WORKS

A visit was made to the Norton plant on October 25th by the Superintendents' Committee of the General Electric Company consisting of the following:

Jno. Riddell, General Superintendent, General Electric Co., Schenectady, N. Y.; E. A. Collins, Technical Supt., General Electric Co., Schenectady, N. Y.; John E. Franzen, Sprague Electric Works, Bloomfield, N. J.; Joseph I. Mitchell, Asst. Supt., General Electric Co., Pittsfield, Mass.; E. A. Barnes, Supt., Fort Wayne Electric Works, Fort Wayne, Ind.; I. F. Baker, General Electric Co., West Lynn, Mass.

In referring to the visit this remark was made: "This visit was of great benefit to us and we now have an entirely different opinion of the cutting wheel business." These words express the sentiments of many practical men after they have made us a visit.

There is a standing invitation to superintendents, master mechanics, foremen or any one else interested in the use of Grinding Wheels and Grinding Machines to visit our works to see how both the wheels and machines are manufactured.

# Norton Company's Medical Department

By Dr. W. Irving Clark, Norton Company's Medical Department

Health a Factor in Considering Labor Efficiency. Plan Adopted to Investigate Health or Efficiency Problem. Equipment and Functions of Medical Department. Care of Accident—First Aid—List of Three Months' Accidents. Physical Examination of Employees—Sick Men Advised—Systematic Record Showing Condition of Health in Norton Plant. Dispensary—Sick Employees Sent to Medical Department by Foreman—Advice Given by Doctor—Memorandum of Sickness Made—Complete Record of Men Sick and Time Lost Always on File.

The Norton Company established its medical department during the latter part of May, 1911.

The department was the outcome of two ideas: first, that a medical department would increase the efficiency of the employees; second, that it would increase the already well-marked good feeling between the men and the company.

As the belief that increased efficiency may be obtained by caring for the physical condition of employees is somewhat new, its basis will be sketched.

In the consideration of production in any given department, practically every mechanical item can be accurately estimated. It would be possible to figure the exact cost and output of any department, provided that all the work in that department, even to the minutest detail, were done by machinery; that is, provided the man question could be eliminated.

If we can keep the health of our men in perfect condition, we have then done much for them and we naturally create a more productive and efficient force of operators.

To obtain the best results for the work at which he is engaged, the man must be in perfect physical health.

The problem of health, therefore, assumes a new proportion in considering efficiency, and we might say that if every man employed were physically well, all departments would run with the utmost smoothness and production.

To produce such an ideal condition is of course impossible, but an approach to the ideal is quite possible.

In an attempt to investigate this problem the following steps would seem rational:—they have been adopted by the Medical Department.

1. Complete physical examination of all employees.

2. Immediate attention to all defects found at examination, and an effort made to rectify the same.
3. Re-examination at regular intervals of employees having physical defects, to see that they are in the best condition possible.
4. Immediate attention to all employees incapacitated by injury or illness, and an effort made to get them into normal condition in the shortest time.

The practical results of such a plan if systematically carried out should be as follows:

1. Immediate elimination of those absolutely unfit for work.
2. An increase in the capacity of the partially unfit by slight changes in work, medicine, mode of life, etc.
3. An exact knowledge of those who may become partially or wholly unfit, and a continued effort to keep this from occurring.
4. A prevention of sickness by advice given to well employees, and by immediate attention to slight ailments.
5. (a) A reduced time of recovery from accidents. Wounds and injuries properly treated at once, heal very much more quickly than if treatment is delayed.  
(b) The elimination of so-called blood poisoning, by proper treatment of wounds.
6. The elimination of active Tuberculosis, Syphilis, or any condition dangerous to other employees.

The outfit and method of the Medical Department in its efforts to carry out this plan, and the results up to the present time, are as follows:

### THE HOSPITAL

This consists of a room of moderate size, well lighted and ventilated by two large windows, and having a carefully selected equipment. It contains a desk, an instrument cabinet, a glass-top table for dressings, a sterilizer for instruments and dressings, and an examining table. Beside this, there are numerous solution bowls, instruments, dressings, etc. In short, it is a miniature dispensary.

### THE PHYSICIAN

The doctor gives about three hours a day at the factory; about an hour and a half in the morning and the same length of time in the afternoon.

In the morning he examines all sick employees applying for treatment, and either prescribes for them, or, if they are sick enough to have to stop work, advises them to call in a physician. In the majority of cases, however, the men have

minor ailments which readily yield to simple treatment.

The afternoon is devoted almost exclusively to making physical examinations.

### THE FUNCTIONS OF THE MEDICAL DEPARTMENT

These are three in number:

1. The care and after treatment of all accidents occurring to employees.
2. The complete physical examination of every employee, and an attempt to remedy all existing physical defects.
3. The examination and diagnosis of and advice to all employees complaining of any sickness whatever.

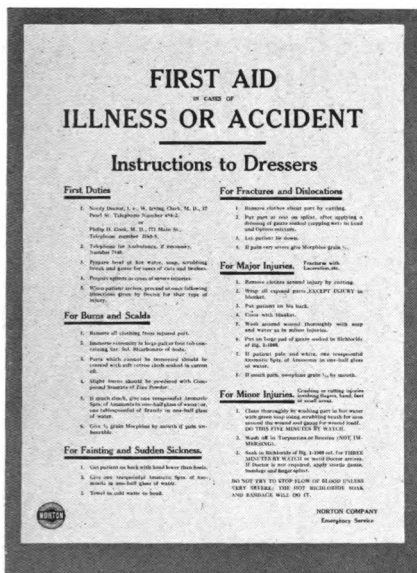
We will now consider these three functions in detail and endeavor to show what has been accomplished in each.

### CARE OF ACCIDENTS

Despite a committee of safety which is continually introducing new methods of prevention, a large number of accidents are bound to occur in any large factory.



First Aid Jar



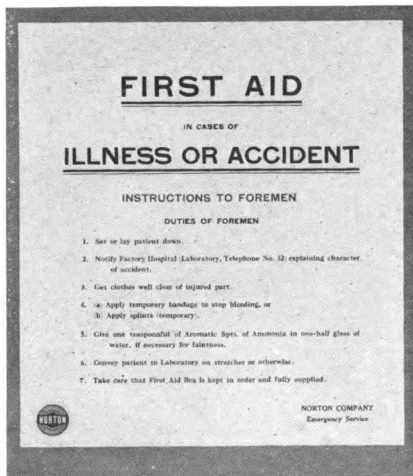
4. Sprains.
5. Fractures and Dislocations.
6. Infections (blood poisoning) and Treatment.
7. Resuscitation from Gas, Fainting, etc.

Each lecture was made as simple as possible, and was illustrated by black-board drawings and actual demonstrations, such as putting on bandages, splints, etc. At the end of this course of lectures an oral examination was held, and since then there have been examinations and conferences about once a month. The foremen have shown great interest in this part of their work, and have ably demonstrated their ability to apply the principles they have learned. At the present time the foremen are coming three at a time to the doctor to put on bandages under his supervision.

Each foreman is provided with a first aid jar containing

- 3 Bandages of different widths.
- 1 Package of sterile gauze pads.
- 3 Finger splints.
- 1 Tourniquet (rubber)
- 1 Measuring glass
- 1 Bottle of aromatic spirits of ammonia.

The jar has general directions on the outside, and there is, in addition, a card



The subjects lectured on were as follows:

1. Hemorrhage and its Treatment.
2. Burns and Bruises.
3. Lacerations and Cuts.

of first aid directions posted in each department.

When an employee is injured the following is the routine:

1. Foreman administers first aid and notifies main office.
2. Main office notifies doctor and trained dresser.
3. Patient is conveyed to the hospital where dresser prepares case for doctor's examination and treatment.
4. Doctor arrives at hospital and cares for the case.

All cases of foreign body in the eye are cared for by the doctor in person. When the body is a particle of steel or Alundum which has penetrated the clear part of the eye, the eye is dressed and patient sent immediately to an oculist for operative removal. Unless treated with the greatest care these cases are apt to result in permanent injury to vision.

While our system of caring for accidents has not been in force long enough to make any statistical statement, we can say that no clean injury has become septic, and that no employee has been obliged to be absent from work more than a week, except two very severe eye cases. In the majority of cases the patient has been able to return to work immediately after treatment.

The type of injury met at the factory may be seen from the following list, which is of the injuries received during the past three months.

### ACCIDENTS

#### Wounds:

|                                       |    |
|---------------------------------------|----|
| Lacerated wounds of face . . .        | 4  |
| "          "          " eye . . .     | 1  |
| "          "          " fingers . . . | 6  |
| "          "          " leg . . .     | 2  |
| Incised wounds of arm . . .           | 2  |
| "          "          " finger . . .  | 8  |
| "          "          " hand . . .    | 4  |
| Puncture wound of foot . . .          | 1  |
| —                                     | —  |
| Total                                 | 28 |

#### Crushing Injuries:

|                                     |    |
|-------------------------------------|----|
| Contusions of fingers . . . . .     | 6  |
| Compd. fracture of finger . . . . . | 1  |
| Contusion of sternum . . . . .      | 1  |
| Contusion of foot . . . . .         | 1  |
| Contusion of leg . . . . .          | 2  |
| Total                               | 11 |

#### Sprains:

|                        |   |
|------------------------|---|
| of wrist . . . . .     | 1 |
| of thumb . . . . .     | 1 |
| of ankle . . . . .     | 2 |
| of great toe . . . . . | 1 |
| Total                  | 5 |

|                     |       |    |
|---------------------|-------|----|
| Foreign body in eye | Total | 13 |
|---------------------|-------|----|

#### Miscellaneous:

|                                         |    |
|-----------------------------------------|----|
| Papilloma of finger . . . . .           | 1  |
| Burn of face . . . . .                  | 2  |
| Burn of forearm . . . . .               | 2  |
| Abrasion of leg . . . . .               | 1  |
| Infected fingers . . . . .              | 3  |
| Synovitis of knee (traumatic) . . . . . | 4  |
| Total                                   | 13 |

An examination of these statistics shows that, while there are practically no serious injuries, there are many which if not properly cared for, may lead to considerable loss of time.

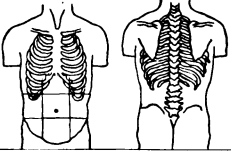
By the method above outlined all injuries receive prompt and efficient attention, and subsequent dressings are done by the doctor until the patient is entirely cured.

### PHYSICAL EXAMINATION OF EMPLOYEES

The physical examination of employees is rather a new departure, but to our minds it is the corner stone in building up physical efficiency.

Each employee receives a complete physical examination.

We believe that, unless a physical examination is complete, it is of little value, because it is impossible to foresee where a weakness may appear which will have a definite effect upon the efficiency of an employee.

| NORTON COMPANY, WORCESTER, MASS.                                                  |     |          |      |
|-----------------------------------------------------------------------------------|-----|----------|------|
| Name                                                                              | No. | Dept.    |      |
|                                                                                   |     | Age      | Date |
| <b>Gen. Appearance</b>                                                            |     |          |      |
| Eyes                                                                              |     |          |      |
| Ears                                                                              |     |          |      |
| Nose                                                                              |     |          |      |
| Throat                                                                            |     |          |      |
| Tongue                                                                            |     |          |      |
| Teeth                                                                             |     |          |      |
| Neck                                                                              |     |          |      |
| Chest Contour                                                                     |     |          |      |
| Heart                                                                             |     |          |      |
| Lungs                                                                             |     |          |      |
|  |     |          |      |
| <b>Abdomen</b>                                                                    |     |          |      |
| Pulse                                                                             |     |          |      |
| Extremes                                                                          |     |          |      |
| Ing. Ring                                                                         |     |          |      |
| G. U.                                                                             |     |          |      |
| Spine                                                                             |     |          |      |
| Skin                                                                              |     |          |      |
| Diagnosis                                                                         |     |          |      |
| <b>Urinalysis</b>                                                                 |     |          |      |
| Color                                                                             |     | Alb.     |      |
| Pro                                                                               |     | Sugar    |      |
| Sp. Gr.                                                                           |     | Microsc. |      |
| React.                                                                            |     |          |      |

Physical Examination Blank

Each employee is therefore examined carefully for defects in all organs, and the results entered upon the card which is shown in the cut.

Any abnormal condition of the chest, back, or abdomen, is charted on the diagram.

After examining a man the doctor discusses his physical defects with him, and strongly urges him to attend to any weakness.

Thus men having ruptures are advised trusses. Those with poor teeth are advised to go to a dentist; and all men are instructed in the importance of the care of the teeth. If any minor disease exists, advice is given, with prescriptions if necessary. The employee is told to report again in two or three days as the case requires. Where there is reason to suspect pulmonary tuberculosis, a sputum examination is made, and where the kidneys are suspicious, a urinalysis is done. We expect to make a complete urinalysis on all employees over 40 yrs. but have not started this work yet.

If the employee examined is too sick to work, he is sent at once to his family physician.

It will be seen from this that every attempt is made to get the men in perfect physical condition to start with. But this is not all. When an employee is found to have a weak heart, and is doing

work injurious to that heart, his work is modified. When a man has a double rupture he is not allowed to do very heavy lifting, etc. Men found having organic disease are required to report at varying lengths of time for examination and advice.

In this way the weak spots of the human machinery are kept under close supervision, and any rapid degeneration prevented.

The results of this side of the work have already been most encouraging. *The men take a great deal of interest in their personal condition, and are quick to appreciate the relief afforded by the simple remedial measures adopted. We have had but one objection in the course of six hundred examinations and the majority of men thank the doctor on leaving the hospital.*

When a man has once been examined, he is pretty sure to return for advice at his first subsequent sickness.

By his examinations and subsequent intercourse with the employees, the doctor is able to get in very close sympathy with his patients, and they will discuss many things with him freely. He is thus able to use his influence to prevent the minor vices such as over-smoking and late hours among the younger men, and, in several cases, has had very gratifying results in his efforts to keep valuable men at steady work who have a tendency to "sprees." Working men will listen to advice from a doctor, and what is more, follow it, when from anyone else it would prove of no avail whatever.

The moral power of the doctor must necessarily become greater as time goes on, and the men become more and more convinced of his good faith, and interest in their physical welfare.

The defects found have been divided into three classes, Medical, Surgical and Special Senses.

1. *Medical:*

|                                 |    |
|---------------------------------|----|
| Catarrhal Jaundice . . . . .    | 1  |
| Nervous Disease . . . . .       | 3  |
| Heart . . . . .                 | 32 |
| Pulmonary TB . . . . .          | 4  |
| Arrested Pulmonary TB . . . . . | 16 |
| Pleurisy . . . . .              | 9  |
| Cirrhosis of Liver . . . . .    | 1  |
| Emphysema . . . . .             | 9  |
| Chronic Arthritis . . . . .     | 3  |
| Acute Bronchitis . . . . .      | 17 |
| Chronic Bronchitis . . . . .    | 3  |
| Indefinite . . . . .            | 4  |
| Head Cold . . . . .             | 4  |
| Indigestion . . . . .           | 2  |
| Constipation . . . . .          | 1  |
| Subacute Gonorrhea . . . . .    | 3  |
| Poss Syphilis . . . . .         | 1  |

Total 113

2. *Surgical:*

|                                   |    |
|-----------------------------------|----|
| Enlarged glands . . . . .         | 29 |
| Tumors (benign) . . . . .         | 14 |
| Movable Kidney . . . . .          | 2  |
| Flat Foot . . . . .               | 19 |
| Varicose Veins . . . . .          | 47 |
| Inguinal Hernia . . . . .         | 43 |
| Synovitis of Knee . . . . .       | 3  |
| Varicocele . . . . .              | 29 |
| Undescended Testicle . . . . .    | 2  |
| Sarcoma of Testicle . . . . .     | 1  |
| Hydrocele . . . . .               | 6  |
| Chr. disloc. of patella . . . . . | 1  |
| Ingrowing toe nail . . . . .      | 4  |
| Hallux Valgus . . . . .           | 5  |
| Old Potts Disease . . . . .       | 1  |
| Furunculosis . . . . .            | 2  |
| Femoral Hernia . . . . .          | 1  |

Total 209

3. *Special Senses:**Eyes:*

|                                |    |
|--------------------------------|----|
| Strabismus . . . . .           | 2  |
| Defect Vision—1 eye . . . . .  | 33 |
| Defect Vision—2 eyes . . . . . | 19 |
| Conjunctivitis . . . . .       | 15 |

Total 69

*Ears:*

|                            |    |
|----------------------------|----|
| Deafness—1 ear . . . . .   | 47 |
| Deafness—2 ears . . . . .  | 72 |
| Discharge—1 ear . . . . .  | 4  |
| Discharge—2 ears . . . . . | 3  |

Total 126

*Nose:*

|                               |    |
|-------------------------------|----|
| Rhinitis . . . . .            | 9  |
| Deviation of Septum . . . . . | 58 |
| Obstruction . . . . .         | 12 |
| Polyp . . . . .               | 1  |
| Ulceration . . . . .          | 1  |

Total 81

We now come to the third function of the medical department which consists in examining and advising all sick employees.

## DISPENSARY

Previous to the establishment of the medical department a sick employee saying he was unable to work was allowed to go home. Now he must apply to his foreman and is then sent to the hospital. There the doctor examines, advises, and prescribes for him. Often it is found that one of the simple remedies which are used at the hospital, will give such immediate relief that the man is able to return to work. If, on the other hand, a really serious condition is discovered, the man is sent home, his physician notified, and everything done to get him under proper care at once.

In connection with the dispensary the foremen are provided with "sick slips," which they fill out in all cases of injury or sickness, giving the date of absence from the factory, and the number of days or hours of lost time. These are filed by the doctor, by department, and the length of absence and cause noted on the original examination card. When the man has left the factory without seeing the doctor, he is sent for on his return, and the cause of his absence obtained. This is then noted on the "sick slip."

| NORTON CO. SICK SLIP.                                                                                                                          |                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| MEDICAL DEPARTMENT.                                                                                                                            |                                       |
| Mr. _____                                                                                                                                      | No. _____ Dept. _____                 |
| Left work at _____ o'clock on _____ 191 because                                                                                                |                                       |
| Sickness of Accident and returned to work on _____ 191                                                                                         |                                       |
| having lost _____                                                                                                                              | Days _____ Hours _____ because of it. |
| Foreman _____                                                                                                                                  |                                       |
| Foreman must fill out this slip AT ONCE upon return of sick or injured employee to work, and file IMMEDIATELY in office of the Superintendent. |                                       |

All physical examinations are filed by name and two lists are kept, one of normal men, the other of those having defects. By this system the exact physical condition of each employee is known, as well as any sickness or accident he may have had; and the length of time he has lost by each.

By turning to the "sick slip" file, the number of cases of sickness or accident in any department may be immediately

|                               |   |
|-------------------------------|---|
| Chronic Alcoholism . . . . .  | 1 |
| Moth Poisoning . . . . .      | 1 |
| Conjunctivitis . . . . .      | 3 |
| Furunculosis . . . . .        | 1 |
| Fabricula . . . . .           | 2 |
| Dermatitis . . . . .          | 1 |
| Chr. Rheumatism . . . . .     | 1 |
| Subacute Bronchitis . . . . . | 2 |
| Tape Worm . . . . .           | 1 |
| Toothache . . . . .           | 1 |
| Hemorrhoids . . . . .         | 1 |
| Tonsilitis . . . . .          | 3 |
| Constipation . . . . .        | 3 |
| Myalgia . . . . .             | 3 |
| Sciatica . . . . .            | 1 |
| Jacksonian Epilepsy . . . . . | 1 |
| Ac. Laryngitis . . . . .      | 3 |
| Inguinal Pain . . . . .       | 1 |
| Acute Pharyngitis . . . . .   | 2 |

Total 63

In closing we would have it distinctly understood that this is only what would be termed, in medical parlance, a preliminary paper. The work has been going on only six months, and the development has naturally been slow. It will be several years before statistics can be obtained to show whether or not efficiency has been promoted. However, as far as we can judge from the small data at hand, there is good reason to hope that ultimately a high degree of physical efficiency may be achieved, as well as a closer sympathy between the employees and the company.

seen, as well as the names of the men, the disease or accident causing the absence, and the amount of time lost.

The dispensary function of the hospital is growing in popularity among the men, and it is hoped that the intercourse between doctor and employees will promote additional good feeling between the employees and the company. The medical cases which have been treated during the past three months, and the number of cases are as follows:

#### Medical Cases:

|                             |    |
|-----------------------------|----|
| Chronic Gastritis . . . . . | 1  |
| Ulcer of Duodenum . . . . . | 1  |
| Gastro-Enteritis . . . . .  | 20 |
| Acute Rhinitis . . . . .    | 6  |
| Hiccoughs . . . . .         | 1  |
| Muscular Pain . . . . .     | 2  |

With this issue of "Grits and Grinds" we start a department under the heading "Abstracts from Current Articles Pertaining to Grinding." Under this heading, each month, we will note various articles on grinding that have appeared in the current trade and technical publications. This page will serve as an index where information on grinding can be found. We believe that if readers of "Grits and Grinds" will remember to refer to this index when looking for information on grinding, it will prove to be of great benefit to them.



# Abstracts from Current Articles Pertaining to Grinding

Descriptive Index or Synopsis of Articles Pertaining to the Grinding Industry that Have Appeared in Recent Issues of Technical and Trade Publications

"Removing Emery Dust from the Shop," by James Clark. How one man eliminated his dust trouble, with illustrations showing arrangement of fan and piping. *American Machinist*—Sept. 14, 1911, page 521.

"Economy in Grinding." A short memoranda on grinding wheel practice. *The Canadian Industrial Review*—Aug. 1911, page 236.

"Facts About Polishing," by W. F. Ford. A discussion of the equipment of a polishing room bringing out care used in handling polishing wheels. The following grains (Alundum) were recommended: for "roughing," Nos. 20 to 80; "dry fining," Nos. 90 to 120; "finishing," Nos. 150 to XF. *American Machinist*—Sept. 21, 1911, pages 541-542.

A Vertical Surface Grinder. Short description with illustration of automatic machine built by Hemming Bros. Co., New Haven, Conn. *American Machinist*—Sept. 21, 1911, pages 565-566.

Valve Grinder. Description of machine developed by R. K. Le Blond Machine Tool Company, Cincinnati, Ohio, for grinding angular seats on automobile valves. *Iron Age*—Sept. 21, 1911, page 648.

"The Work that Kills," by Earl Mayo. An article on conservation of the human resources of the country especially in industrial processes. Cuts of old style and modern dust systems. *The Outlook*—Sept. 23, 1911, pages 204-205.

"Grinding Hardened Gears," by E. H. Pratt. A method of grinding gears in overcoming hardening errors to secure a noiseless transmission. *Machinery*—Sept., 1911, page 6.

Gardner Vertical Spindle Disk Grinder. Article with illustrations showing what

is said to be the largest disk grinder ever made. The disk, which is 53 inches diameter and weighs 700 pounds, is mounted on a vertical spindle and revolves in a horizontal plane. *Machinery*—Sept., 1911, page 59.

Ingersoll Cutter Grinder. An improved type of cutter grinder designed to sharpen large inserted-tooth milling cutters. *Machinery*—Sept., 1911, page 63.

The Besly Disk Grinder. Description of a new pattern makers' disk grinder. Nine illustrations show various attachments to be used for jointing, bevelling, mitering and finishing wood work where fine finish, exact angles and accurate dimensions are required. It is claimed to be a great time saver over old methods. *Iron Age*—Oct. 19, 1911, pages 862-863.

"An Angle Cutter Grinder," by K. H. Crumrine. A short sketch with cut showing method of grinding 45 degree milling cutters by use of a special fixture. *American Machinist*—Oct. 26, 1911, page 795.

"A High Speed Grinder." Description and illustrations of a high speed internal grinder recently put on the market by the Waltham Watch Tool Co., Springfield, Mass. The spindle has been run at 30,000 R. P. M. for 10 hours continuously. The table is operated by a cam mechanism by which any length stroke can be obtained. Any change of stroke can be made while the machine is in motion. *Machinery*—Nov., 1911, pages 223-224. *American Machinist*—Oct. 26, 1911, page 806 and Nov. 2, 1911, page 853.

"Moving a Grindstone in China." Cut showing unique method of transportation in the far East. *Popular Mechanics*—Nov. 1911, page 678.

## What Constitutes Running Balance

By C. H. Norton, Norton Grinding Co.

**Running Balance not Generally Understood. Each Part of a Revolving Body Should Run True Whether Running Separately or Assembled. Balancing Must be the Last Operation. An Object in Perfect Running Balance at One Speed is in Running Balance at All Speeds**

With all the skill and general knowledge of mechanics, it seems a little strange that men have not fully grasped the question of running balance. Static balance is understood by every one, but running balance seems not to be understood by very many.

As an evidence of this, it may be well to consider what is happening in everyday practice in connection with the automobile industry. Many automobile makers who send their revolving parts to the Norton Grinding Company, in order that they may demonstrate the running balance machine for this work, will send the crankshaft and fly-wheel put together and made so that it is practically impossible to separate them in order to balance the parts, and be able at the same time to replace them and have them run true, and consequently in balance. They almost invariably omit to send the other revolving parts; that is, the other member of the clutch and any other parts that may be revolving on the same axis. And, when testing out these balanced parts afterwards, they put onto the same axis other parts that have not been put in running balance, and therefore they do not get good results.

The very fact that a thing is in balance settles the question as to its being changed in form afterwards; that is, balancing must be the very last thing done to that object, if we would still maintain running balance. It goes without saying that a fly-wheel for a crankshaft, if put in running balance, cannot be turned up on the shaft afterwards in order to true it.

To be successful with running balance, each individual member of a revolving body, like the crankshaft, the fly-wheel and the clutch, must be made so accurately that they will run perfectly true,

whether they are running separately or assembled. There is no such thing as balancing objects and then putting them together and truing them up in place. The truing up, as a matter of course, will destroy the balance; and it is not correct to balance these objects when they are all put together, for the reason that one can never tell whether he is balancing that object by itself or whether he is balancing it by placing weights or removing weights from another member that does not require balancing, and therefore setting up bending strains between the fly-wheel and the crankshaft, clutch, etc.

As a matter of course, if we would stop and think about it, the only way to have truly running balanced crankshaft, fly-wheel and clutch is to so construct these three members that they will run true within the limits required whether they are together or whether they are separate, and then each one should be balanced by itself. We will then come nearest to the absolutely correct running balance.

The old tradition that a thing must be all together when balanced seems to prevail with a great many. Why this idea ever took root it is hard to say, but it is certainly very difficult to put in running balance a crankshaft and fly-wheel when they are so constructed that the separation of them would cause them to run out of true when re-assembled.

There is still, also, a notion that running balance means that the object must revolve when being balanced at the same speed it is to revolve when in use. Experience with the running balance indicating machine has proved that this is a fallacy, and that an object in running balance at one speed is in running balance at all speeds.

## Some Popular Fallacies About Cylindrical Grinding Explained

Excerpts from a Talk to Salesmen, by C. H. Norton

**Whether the Wheel or the Work Traverses is Unimportant Except as a Means of Obtaining a Correct Design for Accuracy and Ease of Operation. Erroneous Notions About Use of Fine Wheels, Truing Wheels and Turning**

I assume that while all dealers and salesmen cannot become perfected in their knowledge of grinding machines and cannot be specialists in that line, yet it is their desire to know something about grinding machines, and to be able to talk about them intelligently. That being the case it is well that they should understand something about the popular fallacies in connection with these matters and be prepared to answer them.

One popular notion is that there is some particular virtue in a grinding machine because the work table traverses, another that the other machines on the market where the wheel traverses instead of the work, have some particular virtue in this over the other.

Now it does not make, in my opinion, one particle of difference whether the work traverses by the wheel or the wheel traverses by the work, so long as other things are equal. If the designer in either case has hit upon a plan for the various mechanisms in connection with the machine whereby he gets accuracy, whereby he is assured of accurate diameters at the will of the operator, and does get accurate work upon the machine, it makes absolutely no difference whether the wheel traverses or whether the work traverses. We believe that we have selected mechanism of such a nature as to secure accuracy of diameter at the will of the operator and that we could not have selected this mechanism if we had been obliged to do so with the wheel traversing. This is a matter of design, and it is, in my opinion, a sign of ignorance on the part of any mechanic to advocate either method of traverse as being better than the other. If, in his criticism of one or the other, he shall point out some defect in the design or arrangement of the parts whereby

accuracy can or cannot be secured, there will be some intelligence in his conversation; but if he points out that one machine must be superior to the other because the table does move by the wheel or because the wheel does move by the work, in my opinion, it is a sign of ignorance of the question. So it is well for us not to be too cock sure which machine is the best until we know all about both.

Another popular fallacy is that in order to secure a wheel to grind fine surfaces the wheel must necessarily be of fine grain. This is a common mistake, and leads to a great deal of misunderstanding.

It is also a mistaken notion that it is economy to avoid truing the wheel. On the other hand, it is true economy to true the wheel perfectly true often. Of course, we are referring now to cylindrical grinding and in any talk of this kind it is well to understand the difference which may exist between cylindrical grinding and any other kind.

There is another popular fallacy that work should be turned very close to size in order to grind. They assume that the grinding machine can remove only a small portion of metal and continue to make the mistake of spending valuable time and money in turning work accurately on an engine lathe.

The facts are that the present day grinding machine is so designed, with sufficient power, rigidity and accuracy, that the work need not be turned accurately, and the engine lathe to-day is merely a roughing tool in fact. It remains simply for the public to come to the understanding of the fact that the grinding machine makes entirely unnecessary accurate turning, and thereby is in a position to decrease the cost of producing ground work and at the same time give accuracy.

# GRITS and GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASSACHUSETTS

1911

DECEMBER

1911

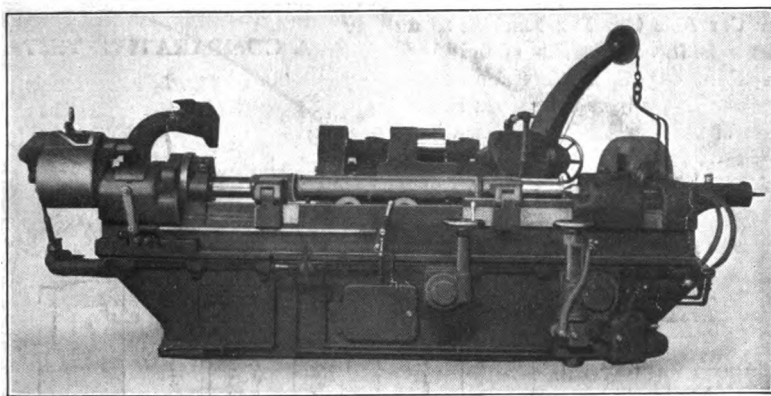
UNIVERSITY OF ILLINOIS  
LIBRARY-CHEMISTRY

## The Norton Car Axle Grinding Machine

**A Machine that will Revolutionize Methods of Finishing and Repairing Axles—  
A Method that Prolongs the Life of the Axle, which means a Remark-  
able Saving—Successfully Demonstrated—Some of  
Its Features**

The latest addition to the extensive line of cylindrical grinding machines manufactured by Norton Grinding Co., Worcester, Mass., is a special machine for

experience in removing metal by grinding. The kind of usage that such a machine would receive in railway shops was fully considered and the object aimed at was to



**Fig. 1. Axle on Centers; Hoist for Handling Grinding Wheel at Right**

grinding railway car axles. It may be used for grinding new axles as well as for repairing old. It is a single purpose machine, designed for durability, simplicity and effectiveness.

This axle grinding machine is a pioneer in a great field of usefulness. The manufacturers have embodied in its design suggestions resulting from ten years'

save time and increase economy, save steel and prolong the life of car axles.

It is the outgrowth of suggestions by railroad men that there would be a large saving if it were practicable to grind axles in commercial time with a modern grinding wheel. The saving would be due to the fact that when grinding it is necessary to remove only sufficient metal from the

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surface to make the axle round and true, while when repairing axles by turning rarely less than  $\frac{1}{16}$ " is removed from the diameter and very commonly  $\frac{1}{8}$ ". This amount in most cases is from three to four times what would be necessary to make the axle true and round by grinding. Saving in axles, therefore, by grinding instead of turning would amount to an enormous sum of money annually and would fully warrant a substantial, rigid machine of sufficient weight and quality to produce the best work with a minimum expenditure of time.

The results already accomplished, through exhaustive tests and trials, point to the new Norton Car Axle Grinding Machine as a big factor in future methods of finishing and repairing car axles. Several successful demonstrations have been given in the presence of interested railway men, when the production was as shown by the following detailed report:

The records below show the time required for grinding various elements of the shaft, also the H. P. used, as well as information regarding the grinding wheel. Since the first demonstrations, of which these figures are a report, further experiments have been made with a newly designed grinding wheel which have resulted in a material reduction in the grinding time; in fact, the more recent experiments have resulted in an average production of three complete axles per hour; all the parts ground as in Fig 4.

It is expected by the manufacturers that still further improvement in time will be obtained.

## A COMPARATIVE TEST

Referring to Fig. 5, attention is called to the fact that these samples have been rubbed parallel with the axes with bronze rings which are shown in the photograph. These bronze rings are made with per-

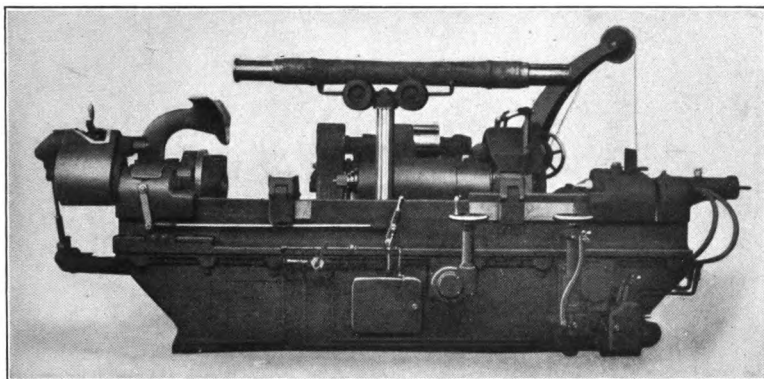
Time Required for Grinding the Various Elements of the Axle. See Fig. 4.

| Axle number .....                | 2         | 3         | 5         | 6         | 8         | 10        | 11        |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Time .....                       | Min. Sec. | Min. Sec. | Min. Sec. | Min. Sec. | Min. Sec. | Min. Sec. | Min. Sec. |
| Putting in .....                 | 7-20      | 1-12      | 1-12      | 1-32      | 1-27      | 0-56      | 1-06      |
| Grinding right hand .....        | (A) 0-45  | 0-34      | 1-14      | 0-18      | 1-03      | 0-37      | 0-28      |
| End .....                        | (B) 7-20  | 5-51      | .....     | 2-58      | 7-51      | 6-22      | 4-09      |
|                                  | (C) 1-45  | 1-30      | 2-22      | 0-42      | 1-34      | 1-53      | 1-08      |
|                                  | (D) 3-00  | 2-51      | 5-44      | 2-12      | 4-15      | 1-46      | 2-42      |
| Turning work on centers .....    | 1-25      | 1-48      | 1-32      | 1-25      | 1-17      | 0-48      | 1-22      |
| Grinding left hand .....         | (A) 1-45  | 0-37      | 1-14      | 0-44      | 1-04      | 0-56      | 0-49      |
| End .....                        | (B) 7-15  | 3-30      | 8-02      | 5-07      | 7-58      | 8-05      | 5-53      |
|                                  | (C) 3-05  | 0-57      | 1-58      | 0-58      | 1-07      | 2-18      | 1-28      |
|                                  | (D) 4-00  | 2-14      | 3-52      | 3-11      | 4-03      | 2-56      | 3-32      |
| Removing work from machine ..... | 1-40      | 1-04      | 1-16      | 0-59      | 1-03      | 1-12      | 1-12      |
| Total time .....                 | 33-25     | 22-08     | 27-14     | 20-16     | 32-42     | 27-41     | 23-49     |
| Maximum horsepower .....         | 42.0      | 29.1      | 40.1      | 29.2      | 34.0      | 32.0      | 35.4      |
| Average horsepower .....         | 17.1      | 11.9      | 16.3      | 11.5      | 17.1      | 13.5      | 12.75     |

Motor running light requires  $3\frac{3}{4}$  horsepower.

Motor and machine running light require 6.44 horsepower.

Wheel, 24 in. diameter, 9 in. face; speed of wheel, 1,036 r. p. m.; surface cutting speed, 6,500 ft. per min.

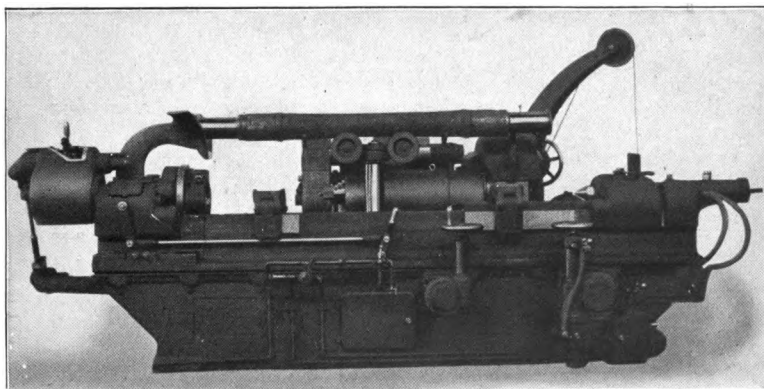


**Fig. 2. Axles Raised by Compressed Air and Ready for Turning**

fectly cylindrical bearings. The act of rubbing parallel with the axis slightly abrades the high spots. This was done without the use of abrasive material between the rings and the samples, the abrasion being caused wholly by the friction of the bronze metal on the steel. This method reveals the actual condition of the bearing, something which is impossible to observe when the bearing is simply ground, or turned and polished. It will be noted that the ground specimen shows practically perfect bearing over the entire surface. In other words, according to this exposition, practically every particle of steel touches the ideal ring, whereas the other two specimens show high and low places and they further show that such

work has not only high and low rings, but that these high and low places are eccentric with each other and do not continue around the entire circumference. In other words, they show that the film of oil between the box and a revolving journal made in this way cannot be uniform throughout the entire revolution, hence the tendency to heating when the journal is new must be greater than would be the case with the ground journal.

The designers also call attention to the point that with the ground surface, before the ring is rubbed upon it, there is a grain due to the grain of the grinding wheel. This, it is believed, will permit more perfect lubrication than would be the case with a bronze surface. If this lubrication



**Fig. 3. Axle Lowered into the Saddles**

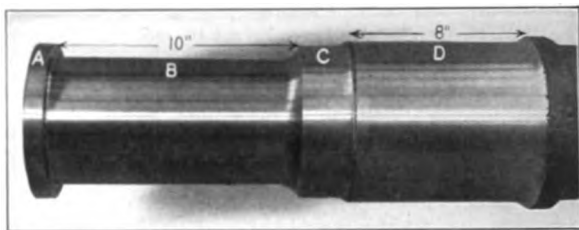


Fig. 4. End of Axle After Grinding

is good when the journal is first put into use, the journal will not heat, whereas with the other methods shown in the photograph the high spots coming around in an irregular, eccentric manner must cut through the film of lubricant and cause heating.

The photograph and explanation are included for the reason that a number of railway men when examining the ground journals have apparently been comparing them with some polished or mirror surface which they have seen on journals, and the company wishes to bring out the fact that ground journals, although they do not have a mirror surface, will give better results because they have a perfect cylindrical bearing where every particle of steel of the surface has exactly the same radius, thereby forming a perfect cylinder, the only qualification to this statement being the grain of the surface due to the grinding wheel; but even with this grain on the surface there are still many more particles of steel at the uniform radius than in the

case of surfaces finished by the other methods. A journal with a mirror finish will not lubricate as well as will the perfect cylinder with grain surface. It is further maintained that the imperfections in the turned and polished, and the turned and roller burnished specimens are not uniform. They do not continue around the entire circumference. They are eccentric with each other and have various other imperfections which prevent any uniformity of bearing and therefore a uniform thickness of lubricant between the box and the journal is impossible.

### FEATURES

Special attention is called here to some of the features which will give the practical man an idea of the line of thought carried out in the entire design.

The total weight of the machine is about 23,000 lbs.

The weight of the grinding wheel head, with revolving parts including wheel and wheel guard, is 5,000 lbs. The weight of the grinding wheel head gives an idea of the rigidity of the machine, this being necessary to secure smoothly finished journals under the maximum removal of stock with the grinding wheel.

It is motor driven, one motor supplying the power for all the elements of the machine. The motor is constant speed and may be any make, voltage and current.

The pump delivers about 50 gallons of water or lubricant per minute upon the wheel and work.

The oilers are not frail brass tubes to become broken or limit the supply of oil, but are cast integral and covered by strong, simple, gravity caps.

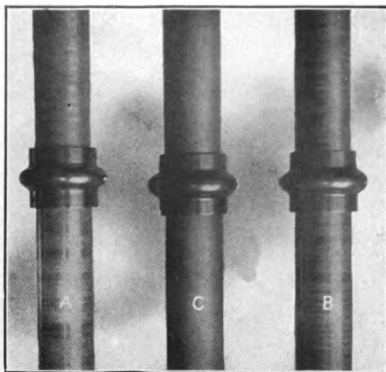


Fig. 5. Condition of Bearings Produced by Three Different Methods

The axle driving gear runs on hardened and ground roller bearings, and the clamp for driving is very massive but convenient.

The table is provided with an air lift by which the axles may be raised or lowered to position. When raising, they are turned around on a ball bearing table on the top of the air piston.

The centers and the foot-stock are of special design, to prevent chatter.

The footstock is without spindle and the whole gives a very rigid axis on which the axle revolves.

The width of the grinding wheels used may be 6", 8", 9" or 10" as required. That is, the journals may be ground with the wheel face equal to the standard length of the journal, or less, as desired. The narrowest wheel provided for is 6", assuming that to be the shortest journal used.

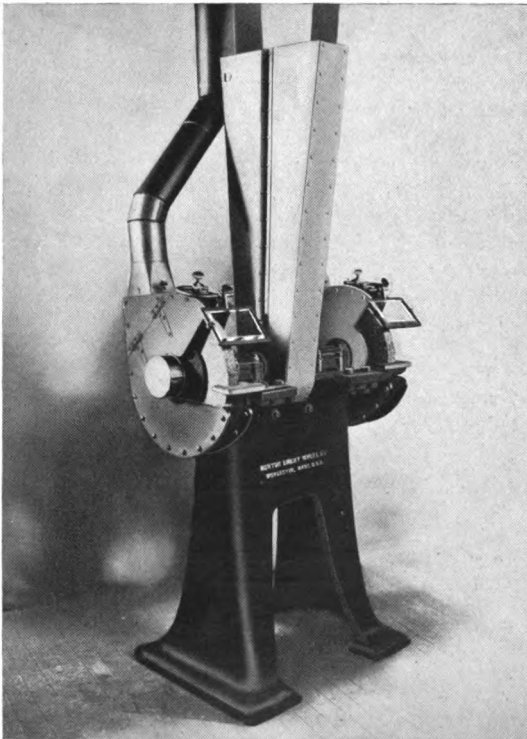
Fig. 1 shows the machine with axle on centers, and also how the wheel is placed on or taken off the grinding wheel spindle by means of a hoist which is a part of the equipment.

Fig. 2 shows the manner in which the axle is raised by means of compressed air for turning on the centers.

Fig. 3 shows the axle being lowered into the saddles, following the turning on the centers.

Fig. 4 is a photograph of the end of a car axle which has just been ground on the machine.

Fig. 5 represents the condition of bearings which have been produced by three different methods: A—turning, filing and polishing; B—turning and roller burnishing; C—grinding with this machine.



**A Well Protected Grinding Machine—Special Attention is Called to the Method of Protecting the Belts and the Efficient Exhaust System—Protection Hoods—Glass Shields for Protection of the Eyes—Close Adjustment of Rests—Nuts Properly Protected.**  
Shown by the Courtesy of National Tube Co., Kewanee, Illinois



## **“The Advantages of the Norton Alundum Filter in the Filtration of Soil Solutions”**

(Abstract of a paper read before the American Chemical Society, Washington, D. C., December, 1911)

By WM. H. ROSS and RAYMOND C. BENNER of Agricultural Experiment Station, Tuscon, Arizona

A comparison was made between the porcelain, the Berkefeld and Norton Alundum Filter by filtering sodium carbonate solutions of a strength approximating those occurring in soils. In one case by filtering 30 cc. the porcelain absorbed 24% of the salt and the Berkefeld 71%. With the former 120 cc. were required to pass through before the original concentration was reached and with the latter double that amount. In the case of the Norton Alundum Filter, absorption was almost inappreciable with solutions of all the alkali salts.

For washing, after filtering a dilute sodium chloride solution, 800 cc. of distilled water were required for the porcelain and 2,000 cc. for the Berkefeld filter, while with the Norton filter 300 cc. proved sufficient.

The water passing through each filter in 2 min. under pressure of  $\frac{1}{4}$  of an atmosphere with the porcelain filter

amounted to 80 cc., with Berkefeld 520, and with the Norton Alundum to 4,800 cc., or to 1,500 cc. with a Norton of finer texture. Even the coarser Alundum does not admit air when filtering by suction with the tube partially uncovered.

The filtrates from the most deflocculated soil solutions containing much “Black Alkali” were perfectly clear except occasionally the first few cc. were slightly turbid.

The new Norton filter has the advantages of filtering without absorption, requires little washing, and filters more rapidly than any other filter. It requires no high pressure system, is very durable and withstands the high ignition necessary for the removal of organic matter in the pores, which makes it more suitable for soil and bacteriological work than the Berkefeld, since the latter is soft and breaks on ignition.

## **“Small Electric Furnaces with Heating Element of Ductile Tungsten or Ductile Molybdenum on Alundum Core”**

(Abstract of paper read before the American Electro-Chemical Society, Toronto, September, 1911)

By R. WINNE and C. DANTSIZEN, Research Laboratory of General Electric Company, Schenectady, N. Y.

The article mentions four furnaces with their chief disadvantages. It then proceeds to describe two simple types made possible by the production of tungsten and molybdenum wire.

The first, designated as a crucible furnace, consists of two Battersea crucibles, sizes O and J, one inverted within the other with the space intervening filled with powdered silica. The bottom of the

inverted crucible is cut off to form a cover.

Within the smaller crucible is an Alundum walled chamber, made of two Alundum cylinders placed end to end, each being 7.6 cm. high and 5.1 cm. inside diameter. The wire of either tungsten or molybdenum is wound in moulded grooves on the outside of these cylinders with a distance of .95 cm. between convolutions. These Alundum cylinders are obtained from the Norton Company, Worcester, Mass.

The winding consists of square molybdenum wire of 1.27 mm. on a side. Hydrogen is led to the lower part of the inner crucible and burns as it escapes from the top. The hydrogen inlet tube and the large copper connections are cemented in place by a mixture of powdered silica and water glass. This furnace can be run safely to 1,700° C., which requires 25 volts and 45 amperes.

The second, called a tube furnace, consists of an Alundum or porcelain tube 46 cm. long, 2.3 cm. inside diameter, wound with molybdenum ribbon 184 mm. thick, 2.54 mm. wide and 445 cm. long. This tube is encased in a thin sheet-iron tube, oxy-acetylene welded and packed with powdered silica. It is supplied with a hydrogen inlet tube and a hydrogen atmosphere is maintained within the casing. 1,600° is readily attained which calls for 80 volts and 14.3 amperes.

These two furnaces are adapted to heating in an atmosphere of hydrogen. When heating in an oxidizing atmosphere the porous Alundum should be replaced by the porcelain to prevent the winding from becoming oxidized.

The article contains diagrams showing a vertical section through the center of each furnace.

## Abstracts from Current Articles Pertaining to Grinding

**Descriptive Index or Synopsis of Articles Pertaining to the Grinding Industry that have appeared in Recent Issues of Technical and Trade Publications**

**Portable Grinders.** Cuts showing new type of portable swing frame grinder being introduced by the Ransom Mfg. Co., Oshkosh, Wis. *Iron Trade Review*—Nov. 2, 1911, page 795. *The Foundry*—Nov. 1911, page 127. *Iron Age*, Nov. 9, 1911, page 1038.

**A Special Grinder by J. K. Tripp.** A grinder built by General Electric Co., West Lynn, Mass., for grinding small shafts, bushings, etc., of less width than face of grinding wheel. The wheel and spindle have no lateral movement. The special feature of this machine is the use of separate motors to drive the wheel spindle and work spindle. *American Machinist*—Nov. 2, 1911, page 831.

**A Draw-In Chuck for the Grinder by H. T. Stokes.** Article and sketches showing a draw-in chuck attachment designed to fit the head of a Bath Universal Grinder. *American Machinist*, Nov. 23, 1911, page 987.

**Surface Grinder.** The J. A. Stowell Co., Leominster, Mass., have recently placed upon the market a new "Saxon" plain surface grinder. The capacity of the machine is 36" length, 10½" width and 12" height. A 10 x 1½" wheel is used. The table traverse being 16 feet per minute. *American Machinist*—Nov. 30, 1911, page 1048. *Machinery*—Dec. 1911, page 312.

**Cutting-Off Machine.** Illustration of machine put on the market recently by the Matson Machine & Tool Co., Bethel, Vt. *American Machinist*—Oct. 5, 1911, page 662.

**Single Head Disk Grinder.** A machine built by the Gardner Machine Co., Beloit, Wis. Of the same general design as the regular line, but with much larger dimensions. Disk wheel 40" diameter; spindle 3" diameter. A 12" pulley with 10½" face. Bearings 10" long. *American Machinist*—Oct. 5, 1911, page 663.

"A Plan of Shop Medical Service." Extract of paper read before the National Machine Tool Builders' Association by Dr. W. Irving Clark, of Norton Company's Medical Dept. American Machinist—Nov. 30, 1911, pages 1141-42.

British Drill Whetstone. A new tool by which drills may be easily and accurately ground upon any flat whetstone or emery board. It is said to produce an absolute pair of cutting lips on drills from  $\frac{1}{12}$ " to  $\frac{5}{16}$ " diameter. Popular Mechanics—Dec. 1911, page 794.

A Shear Blade Grinder by W. A. Valentine. A machine designed to grind blades of power shear. American Machinist—Nov. 16, 1911, page 929.

Ring Wheel Chuck. The Gardner Machine Co., Beloit, Wis., have recently developed a ring-wheel chuck, the body being a one-piece steel casting which is slit uniformly so that a clamping ring acts on the principle of a spring collet. The abrasive wheel extends but one inch from face of chuck and can be adjusted as the wheel wears down. American Machinist—Nov. 16, 1911, page 951. Iron Age—Nov. 16, 1911, page 1087.

A New Luther Foot Power Grinder. A new foot-power grinder made by the Luther Grinder Mfg. Co., Milwaukee, Wis., can be operated in 30 different ways by means of various attachments. The grinder is run by bicycle pedals and bevelled gears. Designed as a tool grinder it is equipped with a universal tool rest and automatic chisel guide to give desired bevel to any tool. Iron-Age Hardware—Nov. 9, 1911, page 77.

A New Tap Grinder. Illustrations of new grinder built by the Bicknell-Thomas Co., Greenfield, Mass., for sharpening taps. American Machinist—Nov. 9, 1911, page 905.

A Grinder Pump by Charles K. Tripp. Cut showing arrangement of pump construction which the General Electric Co. is applying to old style grinders. American Machinist—Nov. 2, 1911, page 845.

"Polishing Wheels" by T. C. Eichstaedt. Article with several illustrations describing compress, solid felt and wool felt wheels; also, various canvas and muslin wheels,

special stress being placed upon the methods of cleaning the wheels for re-setting or re-covering with the abrasive grit. The Metal Industry—Nov., 1911, pages 459-461.

"Polishing" by C. H. P. A method of producing a high polish on iron. The Metal Industry—Nov., 1911, page 479.

Motor Driven Lathe Center Grinder. The Willey Machine Co., Jeffersonville, Ind., have placed on the market a new lathe center grinder which is intended to be mounted on the compound rest of the lathe. It can also be used for grinding milling cutters, reamers, etc. Machinery—Nov., 1911, page 227. Iron Age—Nov. 2, 1911, page 969.

Two New Grinders. Charles Churchill & Co., Ltd., London, England, have placed on the market two new grinders. One is a self-contained motor driven plain grinder and the other a universal and chucking grinder. The former has a capacity up to 10 x 60"; the latter 12 x 36". They can be compared to the plain grinder as a turret lathe compares with the ordinary lathe. The Automobile Engineer—Nov., 1911, page 540.

Continuous Reading Grinder Caliper by Henry K. Spencer. Article with six illustrations showing construction and method of use in connection with a surface grinder. It may be described as a device which measures the work thickness continuously during the grinding operation, showing the operator by means of a dial and the exact amount by which the work exceeds finished size. American Machinist—Oct. 5, 1911, pages 636-7-8.

Grinding Sad Irons from the Rough. Cut showing fixture for grinding edges of sad irons in position on a Besly Grinder. American Machinist—Oct. 5, 1911, page 653.

Ransom Grinding Wheel Guard. Cut shows adjustable guard and dust hood. The guard is made of steel so arranged that wheels can be removed without disturbing the main body of the guard. Manufactured by Ransom Mfg. Co., Oshkosh, Wis. Iron-Age—Nov. 2, 1911, page 982. Southern Machinery—Nov., 1911, page 34.

# GRITS and GRINDS

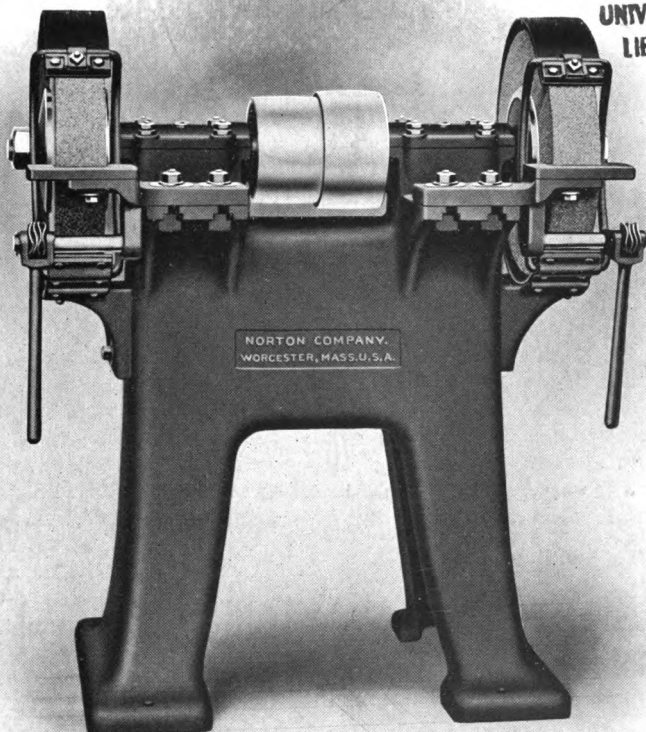
A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASS.

1912

JANUARY

1912

THIS ISSUE IS DEVOTED TO THE GRINDING OF CASTINGS  
OF STEEL AND IRON.



UNIVERSITY OF ILL.  
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Grinding machines for this purpose should be of rigid design, long, well-lubricated bearings and equipped with Protection Hoods. And to obtain best results the grinding wheels used on it must be made of modern abrasives and must be the right grain and grade for the work.

# GRITS AND GRINDS

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January, 1912

No. 9

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## Grinding Castings of Steel and Iron

By R. G. Williams, Norton Company, Dept. of Tests

**Types of Machines Used—Swing Frame, Floor Stands, Special Machines  
Selection of Wheels. Speeds. Use of Dressers. Points to be  
Considered when Measuring Grinding Wheel Efficiency.  
Grains and Grades Commonly Used**

The grinding of steel and iron castings is of such importance that the foundry man is giving much attention to the grinding wheels and the equipment on which they are run.

Accurate methods of keeping costs of these operations are necessary in order that he may know whether he is getting his work done on the most economical basis. This article considers first the machines by means of which steel castings are ground, touching on the important features and adaptability of the different types; then the grains and grades used and the factors which influence same; the class of men doing the grinding; piece-work or day wages, and present methods of measuring wheel efficiency.

### Type of Machine Used

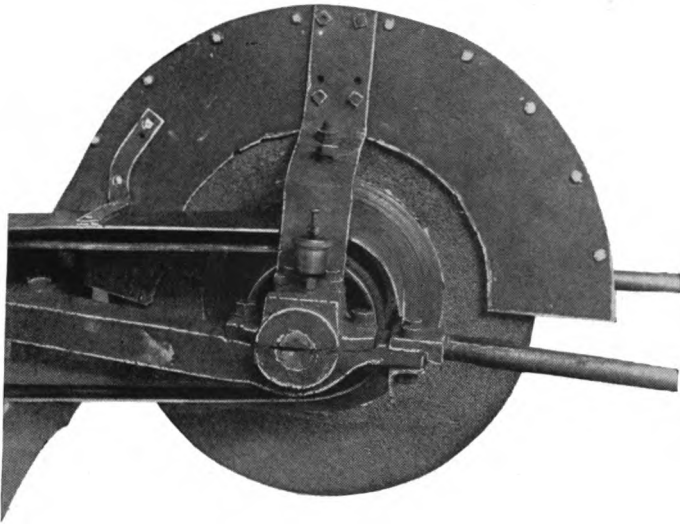
The types of machines used for grinding steel castings may conveniently be divided into the following groups: swing-frame, floor stands, and special machines for semi-precision work.

Swing frame grinders are best adapted where it is more convenient to move the wheel over the casting than the casting over the wheel. Such machines must be free to swing back and forth, sideways, up and down, and it must also be possible

to turn the wheel at an angle. There are three methods of driving the wheel, as follows: belt drive from main line shaft through countershaft, belt drive from individual motor, and wheel spindle direct coupled to armature of motor. Occasionally, one will see a swing frame machine with a rope drive, but it is believed that this method has been discarded for belts on all machines made to-day. Belt drive from main line shaft through countershaft is rapidly going out of use and giving place to individual motor drives. Suppose it is only desired to run one machine in a row of ten or more: with main line shaft drive, it is necessary to run the big motor which uses as much power for one machine as for ten machines. At present, the majority of these motors are constant speed, but grinding wheel users are waking up to the fact that in order to get the highest efficiency out of the wheel, it is necessary to keep the surface speed constant as the wheel wears down. This necessitates the use of a variable speed motor which can be speeded up proportionately as the diameter of the wheel becomes smaller. The type of machine which has the wheel spindle coupled direct to the armature of the motor has one very desirable feature,

namely, there is no chance of decrease in wheel speed under grinding load due to belt slippage. However, it also has the objectionable feature that it is impossible to turn the wheel at an angle. As this is very desirable for some kinds of grinding, it would seem that if the belts were properly taken care of, a belt driven machine equipped with a variable speed motor is the best method of operation to date.

after it is worn down to a certain size, it is found that the frame of the machine knocks against the sides of the bar. By using a wheel which is mounted on the outside of the frame, this difficulty is overcome, since it is possible to use smaller flanges. However, with this outside type of mounting, the weight of the wheel must be counter-balanced by weight on the opposite side of the machine, and the



**An Efficient and Practical Hood for Swing Frame Grinding Machine. Attention is Called to the Belt Guard. Courtesy of National Malleable Castings Co.**

### Swing Frame Machines

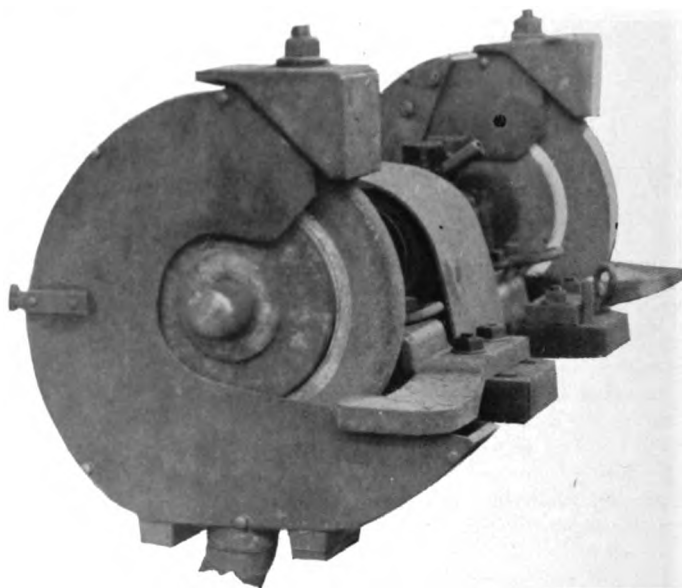
Swing frame grinding machines may further be divided into two sub-classes, as follows: machines which have the wheel in the center of the frame, and outside the frame. From the operator's point of view, the machine which has the wheel situated in the center of the frame is the most desirable to operate, since the weight of the machine is well balanced. But it is often found desirable after wheels have worn down to small diameters to use a machine which has the wheel mounted outside of the frame. The reason for this is that on some kinds of grinding, for instance, the face of a draw-bar, if the wheel is situated in the middle of the frame

operator cannot use his full weight on the wheel during grinding, as this would tend to tip the machine over sideways. A special type of machine is mounted on wheels, making it possible to move the machine from one place to another. Sometimes it is necessary to grind a very large casting, such as a 15-ton ladle. In an early November issue of the "Iron Age" the grinding of such a ladle is described and there is also a cut which shows a swing frame machine mounted on wheels in operation. In order to properly accomplish a grinding operation of this kind, it must be possible to move the machine used through a greater distance than is possible with the ordinary swing frame

grinder, and it is here that a machine mounted on wheels is very well adapted. However, unless there is a good level floor, a thing rarely seen in a foundry, this type of machine is rather impracticable for most uses.

A prominent manufacturer of swing frame grinding machines recommends a 4" belt leading to the wheel spindle. While this width of belt may serve in many cases, in order to reduce to a minimum the possibility of belt slippage, a 5" belt should be used.

of the type of flanges used. A tapered wheel, not of Norton make, was mounted between flanges of a corresponding taper on a swing frame machine, which was fortunately equipped with a well-designed protection hood. A new variable speed motor was being tested out and the master mechanic was taking the speed of the armature for the different plugs on the resistance box. The wheel in question was about 17½" in diameter and when it had reached a speed of 7,500 surface feet



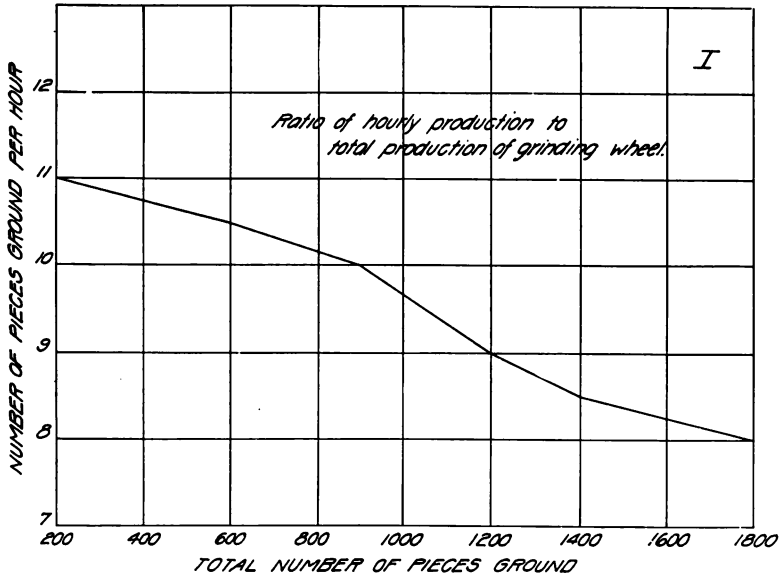
A Well-guarded Floor Stand Used for Grinding Castings. Courtesy of National Malleable Castings Co.

The use of protection hoods on these machines is becoming more and more universal. We have recently received a catalog from a manufacturer of these machines, who also manufactures bevelled wheels, and it is encouraging to see that they show cuts of swing frame grinding machines equipped with substantial protection hoods.

The writer had a very vivid illustration not long ago of the absolute necessity of protecting all wheels with substantial hoods, irrespective

per minute, it broke into about 20 pieces outside the flanges. The portion which was covered by the flanges remained in the flanges. There were about half a dozen men watching the testing of the new motor, and if the machine had not been equipped with a suitable protection hood, serious injury would undoubtedly have resulted.

Once in a while it is found that wheels are carelessly mounted on swing frame machines, but undoubtedly all users of wheels are learning the importance of



The Values for this Curve are Obtained by Trying a Series of Wheels of Different Grades and Observing the Hourly Rate of Production. A Hard Wheel will Last Longer and, therefore, Grind More Pieces than a Softer One, but the Number of Pieces Ground Per Hour will be less. For Example: A Wheel of Such Grade That the Total Production is 1,200 Pieces Ground at the Rate of Nine Pieces per Hour.

proper mounting. Where straight flanges are used, they are almost always relieved, but protection flanges are very seldom found relieved.

All of the swing frame machines made to-day have two stout handles running out in front, by means of which the grinder conveniently operates the machine. However, very few of the machines in actual use to-day are of recent make, and machines are found without any handles at all, the operator simply grasping the yoke; or two very small handles extend out from the yoke and the machine is operated by standing at the side.

#### Floor Stands

You are all familiar with the different types of floor stands and this type of machine will only just be touched upon. For convenience, these may be divided into the following groups:—belt driven from individual motor, individual motor direct coupled to spindle of the wheel, and belt drive from main line shaft.

In like manner, the use of variable speed motors is rapidly becoming as popular as with the swing frame machines. There

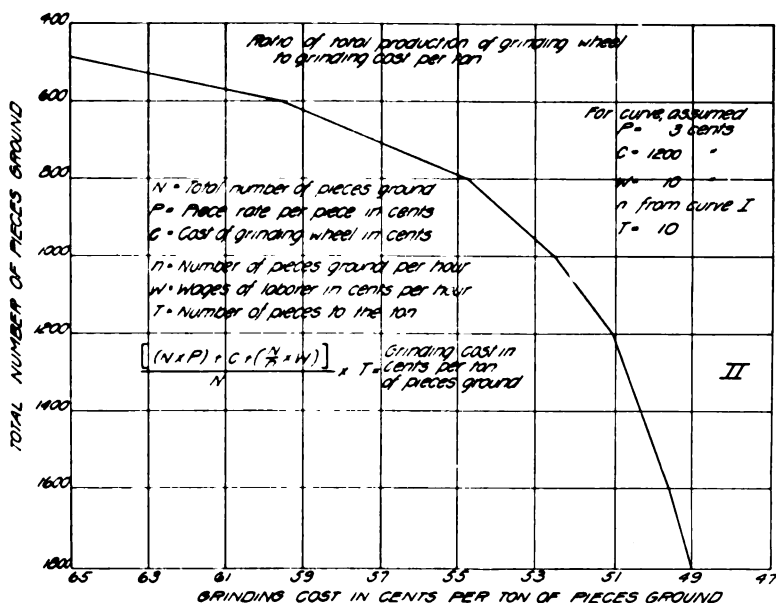
are several types of floor stands now on the market which have the motor attached and it makes a very convenient machine to have in operation. Occasionally, one will find a floor stand which is driven by a chain from the motor to the wheel spindle. Theoretically, this is a good idea, as there is no possibility of slippage to reduce the wheel's operating speed, as with belts. But any advantage this may seem to give is more than neutralized by the fact that chain sprockets wear very rapidly, due to dust from grinding, and frequent repairs are necessary.

Where the castings to be ground are 20 lbs. and lighter, they are generally supported on the rest, but where the castings are heavier, the practice is to hold them in a chain lift, the use of the rest being done away with in this instance.

There are as many different types of protection hoods on floor stands as there are makes of machines on the market, and any type can be called good which affords proper protection to the operator.

The use of dust hoods is rapidly coming into favor and it is found that the ordinary





Curve Showing the Cost of Grinding a Ton of Pieces in Terms of the Total Number of Pieces Ground per Wheel.

protection hood can be made to serve as a dust hood by enclosing the sides and connecting with a suitable exhaust system.

### Special Machines

Special machines that are used for semi-precision grinding are of the lathe type, the boring mill and the shaper types. These are used principally for large, heavy castings which must be ground to approximate size, namely, within  $\frac{1}{32}$ ". The particular field for these machines is in grinding alloy steel castings, it being impossible to machine them.

### Selection of Wheels—Speeds

The grain and grade of wheel best adapted to grind steel castings will naturally vary with the conditions of the particular proposition in question. We have the same general rules holding true as with other types of grinding, namely, machines in good condition can make economical use of a softer grade of wheel than a ma-

chine which is of light construction and has been used roughly. Swing frame grinders and floor stands carry wheels usually from 18 to 24" in diameter and from  $1\frac{1}{2}$  to 3" thick. 6,000 surface feet per minute is the common speed, although 5,000 surface feet per minute is still used in a good many places. Some of our competitors try to tell the wheel user that it is not safe to run a straight-side wheel above 5,000 surface feet per minute, and therefore advocate the use of bevelled or tapered wheels at 6,000 feet. However, the trade is rapidly learning that it is safe and more convenient to run all wheels at 6,000 rather than 5,000 surface feet per minute for grinding castings.

The size of casting usually ground on swing frame machines will vary in weight from 50 lbs. up to 200 lbs. and over. The size of the casting naturally influences the grain and grade to be used, for the following reasons. It is very seldom that the casting is held firmly, so that it can-

not vibrate during grinding, and a large casting, even if just placed on the floor, will absorb more vibration, therefore jar the wheel less than a smaller casting. It is a common practice to place medium castings on planks on a truck while being ground. Such a foundation is very springy, and it will be found that a harder grade of wheel must be used under these circumstances than if the castings were held firmly. The nature of the operation will also influence the grain and grade to use. If the operation consists of simply removing sharp fins and scabs, a harder grade of wheel must be used than if the operation requires the casting to be ground to rough gauge limit. As will be seen, this is due to the fact that where the casting needs to be ground to a rough gauge limit, more or less surface grinding must be done after the fins and burrs are removed.

#### Use of Dressers

The question of using dressers seems to be one on which it is hard to agree. Some wheel users say: "We gave up the use of dressers for a time and we got into all kinds of trouble; the wheels ran out of truth and our production fell down, so we gave back the dressers and let the men dress the wheel whenever it is necessary." The result is that whenever the operator thinks his wheel is getting just a little dull, he immediately starts to wear it out with a dresser.

On the other hand, customers have discarded the use of dressers on snagging wheels, and while they may have experienced some difficulty at first, they soon found that the men kept the wheels true, maintained production at its proper level, and the wheels lasted longer.

#### Wheel Efficiency

Unfortunately there are still a lot of factories which consider that the number of hours a wheel lasts is the only way to look at its efficiency. In other words, they take no consideration of the daily production of the wheel and consider life of wheel of prime importance. Such unfortunate conditions are due in some

places to a lack of care on the part of the "powers that be," and in others, conditions are such that it would be impracticable to try to measure the efficiency by any such means, say, as tonnage produced per day, for sometimes a wheel will be grinding very small castings and at another time very large castings, both of which might require exactly the same amount of material to be removed.

The wheel records, if any are kept at all, as reported by the average user, are also open to criticism.

This matter is usually considered to be of such minor importance that it is entrusted to a boy or a low-priced man.

Wheels of the following grains and grades are most commonly used in grinding castings:

Large steel castings: 10 to 14, grades S and harder.

Small steel castings: 20 to 30, grades P to S.

Large malleable iron castings: 14 to 20, grades Q to U.

Small malleable iron castings: 20 to 30, grades P to S.

Large cast iron castings: 16 to 24, grades Q to U.

Small cast iron castings: 20 to 30, grades P to S.

For semi-precision work, grains 14 to 16 and grades O to Q will usually give satisfaction.

The class of men who do this work are mostly Roumanians, Hungarians or Italians, can rarely speak English, but usually understand thoroughly the art of grinding castings. Both the day wage and the piece work are found in force, although the tendency is toward piece work where such can be established. It is undoubtedly better for the wheel-maker to have the operator paid by piece wage, as it is then possible to get at the production of the wheel per day. While if the men are on day wages and it is up to the foreman to get as much work out of them as possible, it will frequently be found that a wheel will be given credit for running, say 10 hours, when

it was actually in use only  $8\frac{1}{2}$  hours, and sometimes the reverse is true.

The way one manufacturer who pays by the piece expressed the situation was as follows: "We want our men to earn a fair day's wage, and we want you people to give us a wheel with which they can do this, and also which will give us the longest life on that basis." While another manufacturer, who pays by the day, says: "The men can earn \$2.50 per day with any kind of a wheel; we want the one which will cost us the least per hour" (meaning the wheel with the longest life). Under conditions of the first order we know where we are at, so to speak, while under conditions of the second order, the lowest priced and most inefficient wheels are the ones which are liable to be purchased.

The ratio between daily production, piece rate and wages are important factors that must be carefully considered. A very hard wheel will give a very low grinding cost per ton, but the hourly production, or daily production, will fall below the point where the grinder hand can earn a fair day's wage.

The curve sheets shown in this issue illustrate a method of figuring costs.

The curve, on page 6, shows the cost of grinding a ton of pieces in terms of the total number of pieces ground per wheel. It is assumed that the laborer brings the castings to the machine and takes them away after ground. Where it is the practice for the grinder hand to do this, the third expression in the equation does not appear.

An example follows:

Assume a wheel grinds a total of 1,000 pieces.  $1,000 \times 3 = 3,000$  which is the number of cents paid the grinder hand. 1,200 cents is the cost of the wheel. Now, the total number of pieces ground divided by the number of pieces ground per hour gives the number of hours the wheel is in use. The number of hours the wheel is in use multiplied by the hourly rate paid the laborer, which is  $\frac{1,000}{9.6} \times 10 =$

1,042 for the above case, gives the proportion of the laborer's wages which should be charged against the wheel in question.

Adding these factors and dividing by the total number of pieces ground—that is:

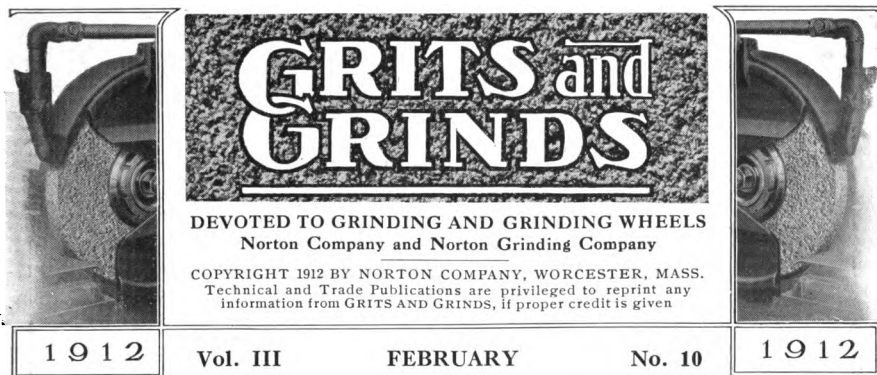
$$\frac{3000 + 1200 + 1042}{1000} = \frac{5242}{1000} = 5.242$$

Thus \$.05242 is the cost of grinding one piece. Multiplying this by the number of pieces to the ton, 10 for the above case, gives \$.5242 as the grinding cost per ton.

We are glad to note that old-rule-of-thumb methods of running factories is rapidly giving way to scientific methods as competition becomes keener, making it possible to conduct conclusive tests, and while some of our competitors make some mighty good wheels, we have yet to be shown that the right grain and grade of Norton wheel, used under the proper conditions, is not absolutely the best thing obtainable.

Grinding points a foundry man should keep constantly in mind for economical operation:

- 1st. Am I using the right abrasive and the right grain and grade of that abrasive?
- 2nd. Do I personally know that accurate grinding records are being kept?
- 3rd. Can my monthly tonnage stand the use of harder wheels which will somewhat cut down the hourly production, but reduce total grinding costs?
- 4th. Should I use softer wheels to get the product out faster?
- 5th. Are the machines in use of heavy, rigid construction? Are they kept in first-class condition? Are the belts wide enough and kept in proper tension? Are wheels run at the proper speeds?
- 6th. Are the grinder hands protected from accident by the use of suitable hoods?



## Scientific American Medal Awarded Norton Company

**American Museum of Safety Recognizes the Norton Pioneer Spirit in Developing and Introducing Safety Devices. Protection Hoods Specially Commended.**

The Scientific American Gold Medal, offered as an award to the institution developing the highest type of safety devices for the protection of life and limb of American workmen, was awarded to the Norton Company at the annual meeting of the American Museum of Safety on Jan. 18th in the United Engineering Societies' Building, New York.

The award represents, as emphasized by the donors, not only a recognition of effectiveness of the devices exhibited in the rooms of the American Museum of Safety, but also the spirit and pioneer work which prompted the winner in developing and introducing safety devices entirely on his own initiative and for the benefit of those using his products. Especially favorable comment was accorded the steel band type of protection hood which has a record of having prevented serious injury in many instances.

The other two medals were: The Travellers Insurance Co. medal presented to the Pennsylvania Railroad Co. in appreciation of what they have done for the protection of lives and limbs of work-

men by means of safety devices and processes. The Dr. Louis Livingston Seaman medal was presented to Dr. Alvah H. Doty, former health officer of the Port of New York, for progress and achievements in promotion of hygiene and sanitation, and mitigation of occupational diseases.

The presentation speech was made by Dr. Frederick R. Hutton, Chairman of the Jury of Award. In his address he stated that in deciding as to the acceptability of a device for this award, the jury was guided by the following requirements:

The first of these is the applicability to a wide variety of conditions or to secure safety for a large number of persons. The second is practicability. The device must be capable of being used economically and successfully and avoid intricacy or cumbrousness, which would interfere with its easy and convenient operation. The third requirement is simplicity, so that ordinary labor or supervision only shall be required to keep it in repair or operation without expert attention. The fourth principle is reliability. The apparatus or

device must not fail in emergency. Durability is the fifth requirement. The device must neither be so delicate nor require such fineness of adjustment that it will not last in service. The final or sixth requirement is commercial availability, so that it shall be capable of being procured by those who would like to use it. It is assumed that no person owning patent rights upon a safety device will so abuse his conferred monopoly as to frustrate the actual purpose for which the device was created. On the principles of the gift and the criteria of award, the chairman of the Bureau is prepared to announce the awards for 1912 at this time.

In awarding the medal to Norton Company, Dr. Hutton said:

"The Scientific American Medal has been awarded to an exhibitor in the Museum, the preparation of whose exhibit for the diminution or prevention of accidents has been painstaking, complete, effective and in every way creditable to both the designers and the installers. Visitors to the Museum will have seen the elaborate exhibit of the designers of the mountings for emery wheels, such as are used for grinding and polishing, sharpening of tools and other service in the machine shop and factory. The successful contributor is the Norton Company of Worcester. The Company is represented by Mr. George N. Jeppson whom I will ask to come to the platform and receive the Scientific American Medal when the speaker shall have made the other announcements.

"By the authority conferred by the State of New York upon the American Museum of Safety, whereby it is authorized 'to promote means and methods of safety to lessen the number of casualties and avoid the cause of physical suffering,' and as Chairman of the Jury of Award deputed by the Trustees of the Museum for this purpose, I now confer upon the Norton Company the Scientific American Medal of the Museum, for its splendid and illuminating exhibit in the Museum, of devices to make safe the operation of the grinding processes in the shop and

factory; and to all honors, emoluments and advantages that attach to such award you are now admitted."

The medal was accepted by Mr. Jeppson, in behalf of the Norton Company, who spoke as follows:

"In accepting this medal for the Norton Company, we realize the high honor which has been conferred upon us by the American Museum of Safety, and we recognize the initiative and the interest of the Scientific American in the great work of safeguarding the American workman from the hazards of his occupation.

"We make in our plants grinding wheels and the machines on which they are used.

"Grinding wheels are operated at high periphery speeds; they are subject to careless usage. There are revolving today in this country alone, by rough computation, approximately a million of these wheels of all makes. There have been many and serious accidents, due entirely to the fact that the operators have not been safe-guarded as they could, and should have been.

"Our company has a record of 1,800 machines that are equipped with protection hoods on which there has never been an accident to any operator, although many wheels have broken in them due to negligence of some kind.

"A safety committee in our own plant, following the general suggestions of this museum, has eliminated accidents to such an extent that for the last six months we have not had an injury of any kind incident to the operation of machinery.

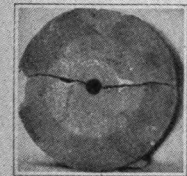
"Following further along these lines our men are examined for physical defects in order that a man with a poor heart, defective sight and hearing shall not be put on an operation which will increase the hazard of his work.

"Mr. Chairman, this medal has already given our men at Worcester a greater interest in the further and better development of the safety devices for which we have been recognized, and for them, and for our company, we thank the donors for making the award possible, and the Museum for the opportunity it has given us for assisting in their great work."

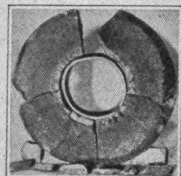
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## SCIENTIFIC AMERICAN

January 27, 1913



## The Third Award of the Scientific American Medal for the Conservation of Human Life and Limb



THE third bestowal of the Scientific American Medal was made with the usual care by the jury of awards of the American Museum of Safety on January 18th at a largely attended meeting held in the auditorium of the United Engineering Societies' building. Three medals were awarded. The Norton Company of Worcester, Mass., extensive manufacturers of grinding wheels, due to their well-developed and carefully thought out accident prevention devices, were awarded the Scientific American Gold Medal. The presentation speech was made by Dr. Frederick H. Hutton, and it was accepted by Mr. George N. Jeppson of the Norton Company.

Dr. Hutton said that there were in brief six criteria to guide the jury in deciding as to the acceptability of a device for this award. He spoke as follows:

"The first of these is the applicability to a wide variety of conditions or to secure safety for a large number of persons. The second is practicality. The device must be capable of being used economically and



Scientific American medal for devices for conserving human life and limb.

devices be created. On the principles of the gift and the criteria of award, the chairman of the Bureau is prepared to announce the awards for 1912 at this time.

"The Scientific American Medal has been awarded to an exhibitor in the Museum, the presentation of whose exhibit for the diminution or prevention of accidents has been painstaking, complete, effective, and in every way creditable to both the designers and the installers. Visitors to the Museum will have seen the elaborate exhibit of the designers of the mountings for grinding wheels, such as are used for the polishing, grinding, sharpening of tools and other service in the machine shop and factory."

In presenting the medals the chairman spoke as follows:

"By the authority conferred by the State of New York upon the American Museum of Safety, whereby it is authorized to promote means and methods or safety to lessen the number of accidents and avoid the cause of physical suffering, and as chairman of the Bureau of Award deputed by the Trustees of the Museum for this purpose, I now confer upon the Norton Company the Scientific American Medal of the Museum, for its splendid and illuminating exhibit in the Museum of devices to make safe the operation of the grinding processes in the shop and factory, and to all buyers, manufacturers, and customers that attach to such award you are now admitted."

Mr. Jeppson said in reply:

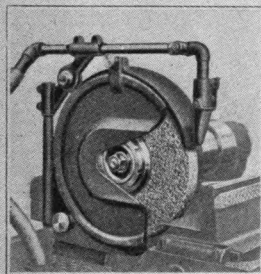
"In accepting this medal for the Norton Company, we realize the high honor which has been conferred upon us by the American Museum of Safety, and we

renew the initiative and the interest of the Scientific American in the great work of safeguarding the American workman from the hazards of his occupation.

"Mr. Chairman, this medal has already given our men at Worcester a greater interest in the further and better development of the safety devices for which we have been recognized, and for them, and for our company, we thank the donors for making the award possible, and the Museum for the opportunity it has given us for assisting in their great work."

From the high speed of rotation of grinding wheels, and the fact that they are of a composite character, consisting of an aggregation of thousands of grains united by a varying binding material, accidents have been very frequent in the past. They have been of such a serious and painful nature that industrialists have given much attention to the largely preventable causes and to minimize the effects of such accidents which may result from causes beyond human control.

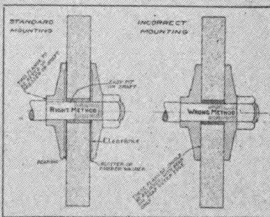
The company has at all times made an effort to foolproof in every possible way all apparatus of its manufacture. In addition to the specially referred to safety devices, accidents from other sources have been



Hood for plain cylindrical grinder.

successfully avoid intricate or cumbersome, which would interfere with its easy and convenient operation. The third requirement is simplicity, so that ordinary labor or supervision only shall be required to keep it in repair or operation without expert attention. The fourth principle is reliability. The apparatus or device must not fail to work in emergency. Durability is the fifth re-

quirement. The device must neither be so delicate nor require such fineness of adjustment that it will not last in service. The final or sixth requirement is commercial availability, so that it shall be available or being presented by those who would like to use it. It is assumed that no person owning patent rights upon a safety device will so abjectly have conferred narrowly as to frustrate the actual purpose for which the

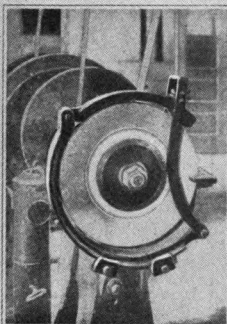


Proper and improper methods of mounting.

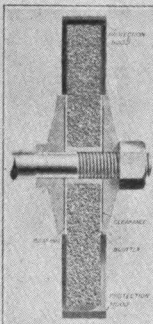
guarded against, by means of proper housings of all parts or other pieces of mechanism, also stops which prevent the mounting of a larger wheel than the given machine has been designed for; dust suction systems for the protection of both operator and machine; leather spark brushes, so attached to the hood as to protect an operator's clothing from sparks; adjustable rests, so

that at all times the rest may be brought up to the face of the wheel, preventing foreign substances from becoming wedged between the wheel and the rest, possibly causing burning; glass shields attached to the hoods in cases where it is desired or necessary to closely watch the work, thus affording protection to the eyes, refractive goggles, which latter, however, are most desirably recommended. Of

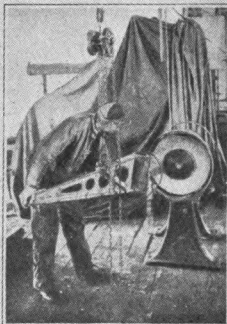
(Continued on page 99.)



Early type of hood showing the fundamental idea.



Section through fully protected grinding wheel.



Grinder protected does not impair the efficiency of the machine.

THE THIRD AWARD OF THE SCIENTIFIC AMERICAN MEDAL FOR THE CONSERVATION OF HUMAN LIFE AND LIMB

# The American Museum of Safety

**Organization—its Objects. Character of Exhibits. Three Departments—Accident Prevention, Industrial Hygiene, and Mutuality. Illustrated Lectures. Organization of Safety Committee.**

The American Museum of Safety, the twelfth institution of its kind in the world and the first in the United States, had its inception in two special expositions of safety in New York City,—the first, in 1907, lasting two weeks, and the second, in 1908, lasting two months.

These beginnings led to the formal organization of the American Museum of Safety, which now holds a special charter of incorporation granted by the Assembly and Senate of the State of New York. The present headquarters of the Museum are in the United Engineering Societies' Building, 29 West 39th Street, New York, where it has on exhibition all kinds of devices for safeguarding the lives, limbs and health of those engaged in industrial pursuits. These quarters are already outgrown, and more space is needed for the waiting list of valuable exhibits and to meet the increasing demands made upon the Museum for detailed safety information.

According to the Museum's special charter—Chapter 152 of the Laws of 1911, State of New York:

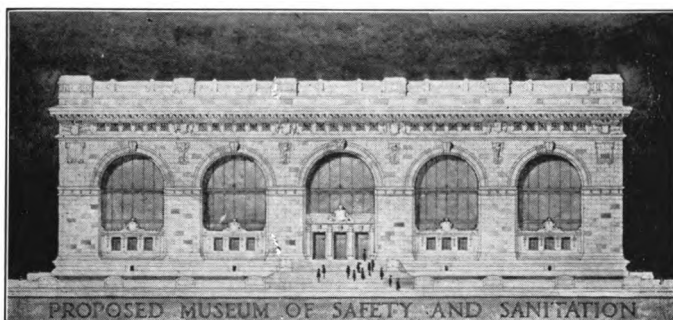
"The objects of the corporation hereby created are to study and promote means and methods of safety and sanitation and the application thereof to any and all public or private occupations whatsoever, and of advancing knowledge of kindred subjects; and to that end to establish and maintain a museum, library and laboratories, and their branches, wherein all matters methods and means for improving the general condition of the people as to their safety and health may be studied,

tested and promoted, with a view to lessening the number of casualties and avoiding the causes of physical suffering and of premature death; and to disseminate the results of such study, researches and tests by lectures, exhibitions and publications."

The American Museum of Safety is absolutely non-commercial. No orders are taken, no exhibits are sold, and no charge is made for space. Many of the devices are not patented, but are practical, home-made appliances evolved in the experience and practice of the individuals or firms exhibiting them. No exhibits are accepted unless they have decided



**Engineering Societies Building  
Headquarters of American Museum of Safety**



**Proposed Building of American Museum of Safety**

safety features, and until they have passed the Museum's Board of Approval, whose personnel is made up of experts in the various industries. Demonstrations are made by the Museum's own staff. The Museum is free to the public and open every day—excepting Sundays and holidays—between the hours of 9 and 5.

The Museum's activities are centered in three great departments—Accident Prevention, Industrial Hygiene and Mutuality.

In the first of these, attention is given entirely to questions of safety and to collecting and exhibiting simple, practical safeguards for dangerous machines and processes, by means of actual devices, models, drawings and photographs. The most highly specialized collection is contained in the Iron and Steel Section, under the chairmanship of Charles Kirchhoff. Here may be found all sorts of safety devices in actual use in the iron and steel and allied industries: safeguards for blast furnaces, open hearth, bessemer, blooming, rail, skelp, slabbing, galvanizing, pipe and wire mills; power stations, yards, shops, electricity and transportation.

These collections are of particular value to engineers, factory inspectors and foremen, who come to the Museum to study them and to make drawings and tracings for the installation of similar devices in their own plants.

The superintendent of a plant employing about 6,500 men, sent a special committee on a three weeks' tour of investigation

of safety devices and methods in western mills and plants. His representative, coming to the Museum, remarked, "I learned more of simple, practical, safety devices in my first visit to the Museum, than I obtained from the collective experience of the three weeks' tour of our inspection committee."

One day, a man walked in with a bulky package done up in canvas. "I got your letter," he said, "and came as quickly as I could." We found that he was too poor to express his model, but he was determined to be present and explain how his elevator cage worked. The next day, a mining superintendent from Western Pennsylvania, who had been detailed by the president of his company to study the Museum, was instantly attracted by this model, saying, after a thorough examination, "That one model has more than paid me for the money and time spent in coming here."

In its Department of Sanitation, the Museum aims to show how factories, mills, workshops and homes may be made sanitary; and especially how to lessen the ravages of occupational diseases. The Department of Mutuality concerns itself with means for promoting the efficiency, comfort and happiness of wage-earners and for bringing about a better understanding and mutuality of interest between employers and employees.

In addition to the specialized collections of devices, models, drawings and photographs which may be studied at the



Museum's rooms, the educational work has been extended by means of free illustrated lectures, at selected centers of industrial and commercial importance. The Iron and Steel Section alone has conducted an educational campaign at mills and plants, where superintendents, works managers, engineers and foremen have assembled to learn what has been accomplished through the introduction of safety devices in their industry. These audiences have ranged from 300 to 2,100 men, and all have been greatly impressed with the simple, practical character of the safeguards described.

By special arrangement, evening lectures have been given at the Museum, before the New York Commissioner of Labor and the State Factory Inspectors, the DuPont Powder Works' Superintendents, the New York Section of the Institute of Mining Engineers, the National Electric Light Association, the Midvale Steel Company's superintendents and foremen, the Society of Hungarian Engineers, the Society of Heating and Ventilating Engineers, the American Electric Railway Association, the Safety Committee of the United States Steel Corporation, and similar bodies.

Another very important branch of the Museum's work is the organization of Safety Committees in shops and works, and furnishing the practical information that is needed for carrying on the work of accident prevention. For example, the Rochester Railway and Light Company, following the suggestions of the Museum, appointed a Committee of Safety, which, in turn, has appointed eight sub-committees to deal with the problems arising in the various departments. A member of a large dry-goods firm in the Middle West, after listening to the Museum lecture and before leaving the hall in which it was presented, formed a Committee of Safety for the establishment, consisting of the electrician, the engineer and himself.

With a view to stimulating the invention and introduction of safety devices in all the industries, and the promotion

of hygiene and sanitation, three Gold Medals are annually awarded by the American Museum of Safety.

The Scientific American Medal of the American Museum of Safety is presented to such individual or corporation as has produced and exhibited in the Museum, within a recent period of years, any practical device which, in the judgment of the Jury of Awards, best conserves human life and limb in the processes of industry.

The Travelers Insurance Company's Medal of the American Museum of Safety is awarded to the American employer, or corporation, which, in the judgment of the Jury of Awards, has in a recent period of years, achieved greatly in the conservation of the lives and limbs of its work-people, by means of safety devices for machines and processes.

The Louis Livingston Seaman Medal of the American Museum of Safety is awarded for progress and achievement in the promotion of hygiene and sanitation and the mitigation of the evils of occupational diseases.

The American Museum of Safety is the only organized effort in the United States for safety in industry and for bringing a knowledge of safety devices and their practical application, to employers, workers and the general public, through its collections, its manuals and leaflets of safety, its special report service and its illustrated lectures.

It is impossible to estimate the far-reaching influence of such an institution, which, to accomplish its widest usefulness, should be housed in its own building with adequate resources for maintaining its great work. This is the present aim of the Museum, one in which every public-spirited man and woman in the United States should gladly co-operate.

The American Museum of Safety is absolutely non-commercial and non-political. The Metropolitan Museum of Art and the Museum of Natural History offer desirable examples, the State providing the buildings, the city giving the land, and private subscriptions providing the current expenses. The same is true of the

Museums of Safety in Amsterdam and Paris, with excellent results.

The American Museum of Safety is the pioneer in this country. On its Board of Trustees, men of the finest public spirit, professional ability and technical skill, are giving their services free to this movement for promoting the conservation of human life. The work is largely educational; by enlisting the aid of the State, city, and a large body of private individuals, its influence will be wide spread.

Geologists tell us that it must have taken millions of years to form the mountains, the plains and the valleys, making the earth ready for the occupancy of man, the flower of creation. With this thought in mind, do we sufficiently regard the sanctity of human life? The American Museum of Safety appeals to every man, woman and child to help, in his own way, to establish on a solid foundation this movement for the protection of human life, the most sacred thing entrusted to the nation.

## Safety Movement World-Wide

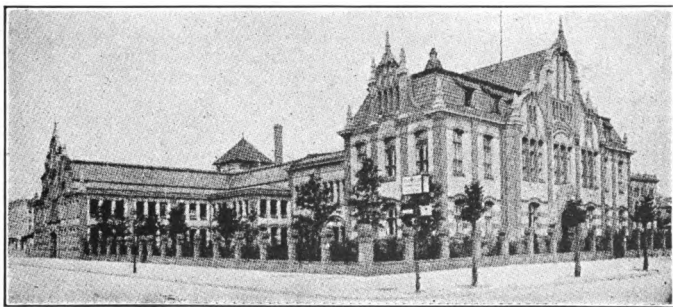
**Fourteen Museums in Europe. One in Canada and one in United States. Equipment and Activities. Clearing Houses of Construction. Thought and Effort. Advantages.**

The movement for safety in industry is world-wide. Already there are fourteen Museums of Safety established in Europe and one in Montreal, Canada. The American Museum of Safety in New York City, is the twelfth in the series and the pioneer movement in the United States.

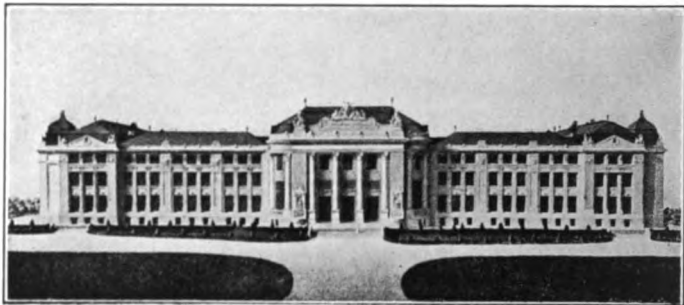
The Berlin Museum of Safety—probably the best equipped of the European Museums,—has 64,000 square feet of space for exhibiting purposes. Wherever possible, the machines are of full size and are power-driven, so as to show the safety devices in actual operation; otherwise,

the application of the safety devices is shown by means of models, drawings and photographs. In the courtyard of the Museum, safety scaffolding, ladders and other appliances for use in the building trades are demonstrated. Within are found various exhaust systems for dust, smoke and vapors; exhibits showing the nutrition of various food stuffs; workmen's dwellings, systems of ventilation, heating—in fact, everything concerning the protection of the workman while at his work or at home.

The Dresden Museum of Safety and Industrial Hygiene—the last in this series



**The Berlin Museum of Safety. Founded 1904. Maintained Entirely by the State**



Vienna Museum of Safety

of life-saving stations, is the outgrowth of the great international exposition on these subjects which was held, last year, in that city, and which, during the six months it was open, was visited by more than 5,000,000 people.

In Germany, the Museums of Safety are supported entirely by the government, which believes that "every life saved is a national asset."

The Amsterdam Museum of Safety, opened in 1893, illustrates ideal co-operation which could be followed to advantage in our own country. The city has given the land, the state the building, and private contributions its maintenance.

The Paris Museum of Safety is housed in the National Conservatory of Arts and Trade, and already has outgrown its headquarters. The other ten European Museums are to be found in Munich, Vienna, Milan, Moscow, Zurich, Stockholm, Copenhagen, Helsingfors, Budapest and Gratz.

For the statesman, the industrialist, the educator, the social economist, the general public and the politician, a Museum of Safety is a clearing-house of constructive thought and effort. Among the advantages may be mentioned:

1. A Department of Safety Devices, where practical, simple safeguards for the protection of dangerous machines and processes may be shown and interpreted, by means of actual machines—

power-driven, models, photographs and drawings.

2. A Department of Sanitation, to show how factory, mill and workshop may be made sanitary, and the best methods of preventing occupational diseases and poisons.

3. A Laboratory, for the perfection of safety devices and processes.

4. A Department of Inspection, through which expert advice is given on any point concerning a more adequate provision of safety.

5. A Reference Library, containing the world's best experience in accident-prevention and industrial hygiene, as set forth in photographs, special reports, documents and other literature.

6. Photographs of safety devices, with descriptive text, to be sent to managers, superintendents, shop foremen and others, in order to show them specimens from which they may select the ones best suited to their needs. This department affords material for sets of traveling photographs, with text, for loan to technical schools, colleges and other educational centers.

7. Free Illustrated Lectures, covering the important points of safety and sanitation, at selected centers of commercial and industrial importance.

8. The organization of Committees of Safety in Industry, and furnishing such technical information as they may need for the prosecution of their work.

## Encouragement of Safeguards and Sanitation in the Factory

The award of the Scientific American Gold Medal by the American Museum of Safety as a "Reward of Merit" for promoting the use of safeguards for the protection of workmen, created a just feeling of pride and satisfaction throughout the entire Norton organization. This interests and encourages us to continue our efforts along these lines and undoubtedly many others will be stimulated by this public recognition to do likewise.

The American Museum of Safety is to be highly commended for its well directed efforts in creating wide-spread interest and enthusiasm in the subject of protection of workmen from accident. Among its growing number of loyal supporters is the "Scientific American" whose activities stand out prominently by offering as a stimulus prizes to those who, in the opinion of a Jury of Award, have accomplished results worthy of such recognition.

In the hope that a review of the work of safeguarding and health protection, as developed and practiced in our own works, will influence and assist others in giving the matter consideration, this "Gold Medal" number of "Grits and Grinds" is devoted to this important subject.

While everything which we have so far undertaken in the introduction of these improvements has been planned primarily for our own advantage, it has redounded to the benefit of not only our own workmen but to other manufacturers and the many thousands employed by them.

The Company early realized the great importance of safe-guarding the man operating in its shop and the man outside using its products. Wheels will burst at times, regardless of the care exercised in their manufacture, or handling. Rarely, however, does a wheel burst that has passed out into the world, due to inherent weaknesses. In practically every instance,

the result is to be accounted for by contributory causes; defects due to handling or mounting, carelessness or abuse, using a wheel not at all fitted to do a certain piece of work, or straining it beyond an allowable limit.

To vitiate the possibilities of serious accidents in the case of wheel breakages, exhaustive experiments and tests have been undertaken in conjunction with a careful study of efficient protection devices. Such work was intrusted to our own especially organized Research Laboratory, well equipped with modern devices and machinery for experimental research work, and which is being constantly maintained and further developed.

In this manner, a number of protection devices have been invented and applied; their effect studied; form altered and improved, as practice has pointed the way for improved efficiency in this most important department.

In connection with this work the Norton Company published in the year 1911 a treatise on "Safety as Applied to Grinding Wheels," which was distributed among grinding wheel users. This booklet contained in condensed form the practical results of the Company's activities in the direction of safe-guarding the life and limb of its own and other workmen, and has been accorded a reception and performed a function pleasing to its sponsors. A second and amplified edition is now in course of preparation.

In addition to this safety booklet, much educational literature, consisting of pamphlets, shop hangers, etc., containing suggestions in connection with the proper selection, mounting and use of wheels, has been freely distributed and has, undoubtedly, been a considerable factor in the very material reduction of accidents.

"Grits and Grinds," in which this subject has from time to time also been more or less thoroughly discussed, has further

contributed to the general breadth of knowledge in this field, and will continue to act as the exponent of this humane work. The publication is devoted exclusively to the grinding industry. The object of the publishers, aside from spreading the knowledge of scientific grinding, is to preach the gospel of safe-guarding the American workman in his daily occupation.

In order to reach "the man at the wheel" in a practical manner, a corps of competent demonstrators is kept in the field. These demonstrators study the practical conditions to be met, and apply the proper wheel to do a certain piece of work; while at the same time, they further assist in developing safety devices and in making the grinding operation a perfectly harmless and safe one. Every demonstrator and salesman is particularly impressed with the great necessity of proper grinding equipment and the proper selection of a wheel for any one given piece of work. It may truthfully be said that Norton demonstrators and salesmen have been the means of safe-guarding many operators in hundreds of shops throughout the world.

In the Norton Company's own works, a Safety Committee constantly exercises its vigilance over the operation in all of the various branches; a Fire Department, well trained and equipped with the most modern apparatus carries the responsibility of the Company's physical property; a relatively new but complete and thorough Medical Department looks after the physical welfare of all of the Company's employees.

The elimination of all accidents of any consequence testifies to the thoroughness with which the Safety Committee performs its functions. In the past six months, there has not been an accident in the Norton shops of any consequence incident to the operation of machinery. Wherever the least possible danger existed, precautions have been taken to guard against such liability.

All belts, wherever exposed, have been enclosed; while gears and other pieces of mechanism have been properly housed.

Dust suction systems have been installed in various departments for the protection of both the operator and the machine.

Dangerous passageways have been provided with gates; while guards have been built around fly wheels.

Accidents at elevator shafts have been guarded against; while many other small details, far too numerous to mention, have been properly provided for.

Furthermore, notices in various languages have been put up conspicuously at danger points.

The extreme care with which this work has been prosecuted is primarily responsible for the elimination of accidents, and a person passing through the works is immediately impressed with a sense of security and protection. The pride and pleasure our men take in making every operation a perfectly safe one is indeed a gratification to the Company.

The Fire Department, well equipped and well trained, consists of outside and inside companies. Occasional fire drills are held, and the promptness with which the alarms are responded to, are an indication of the Norton spirit pervading our works, in which we feel a just pride.

The Medical Department, organized and equipped nearly a year ago, has already proven to be a valuable institution, and holds an enviable record. It is devoted to improved sanitation, safety and comfort of workmen. A thorough, dependable and prompt system has been established for rendering first aid in case of accident; while the department is equally helpful in lending its attention to men taken sick while at work, and also in the building up of a healthy, working organization.

Complete physical examination of every man is undertaken from time to time, while the records are filed for reference, so that the fight against contagion, infection and tuberculosis may be conducted in an organized and systematic manner.

A well equipped factory hospital with the most modern apparatus is maintained, with the staff physician in attendance

every working day. A full report on the object and results obtained up to that time by the Medical Department was published in the Nov., 1911, issue of "Grits and Grinds."

Modern ideas of factory management are exemplified in the Norton works, where dining rooms, reading, smoking and rest rooms, sanitary wash rooms and other helpful arrangements for the pleas-

ure, comfort and well being of its employees are provided.

The Company further systematically encourages outings and social functions which tend toward closer and more friendly relations between the various departments of the shop, as well as between the shop and the offices; thus making for good fellowship and co-operation necessarily reflecting favorably upon the efficiency of the organization as a whole.

## Protection Hoods

**The Only Real Protector—Thoroughly Tested out—Hoods Should Always be Used—Relieved Flanges.**

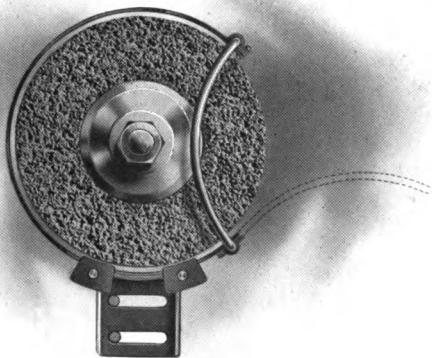
The most important safety device, in connection with grinding machinery, is the hood enclosing the wheel which in case

shape, tending to straighten out the link.

Repeated tests on wheels which have been speeded up to the bursting point, many times the normal working speed, have shown that the broken pieces fall harmlessly to the floor without injury to the man or machine.

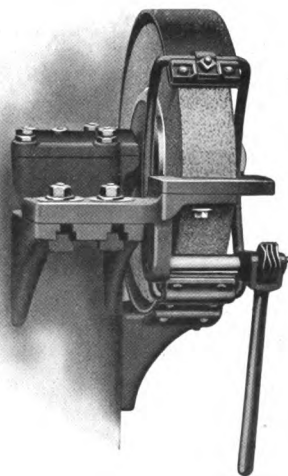
This hood can be adjusted to meet different requirements.

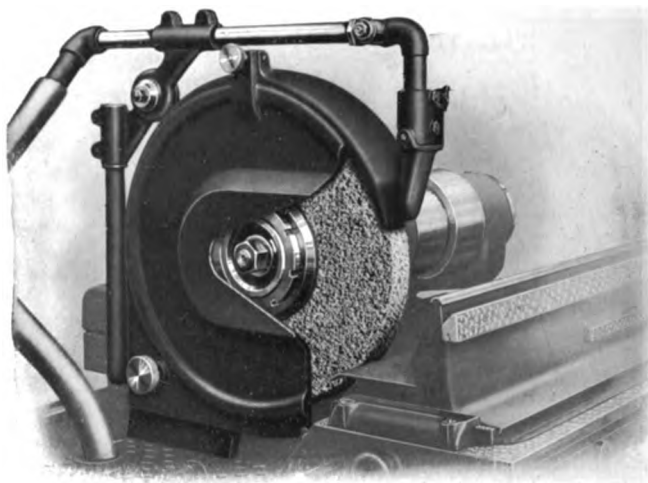
The more enclosed type of hood shown here is used on Norton Plain Machines for Cylindrical Grinding.



of accident prevents the broken pieces of the wheel from doing damage to nearby objects or injuring the operator, or others.

The hood shown here consists of a circular band of boiler plate somewhat wider than the wheel it covers. The protecting band is cut out for about one-fourth of its circumference and the two ends are joined together by means of a one-piece steel link. This hood has a considerable degree of elasticity which, under actual breaking conditions, permits the hood to bend out of



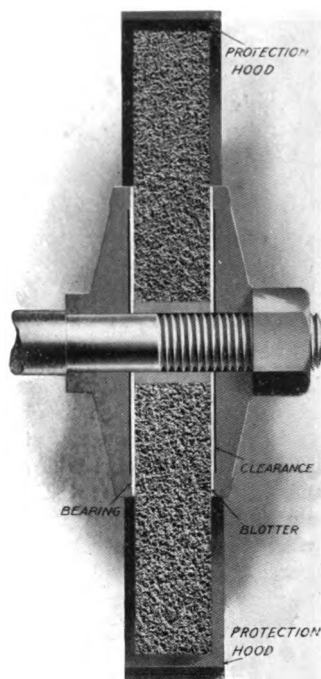


Protection Hood used on Norton Plain Grinding Machine

Many designs of hoods had been devised, experimented with and brought out before these types were finally adopted. Eighteen hundred of these machines are in daily operation and as yet not a single injury, due to wheel breakage, has been recorded.

Protection hoods should always be used, if possible, even where protection flanges are employed, as the protection flange can be only a partial safety device. The flange cannot possibly hold that portion of the wheel not covered by it from being thrown off. The hood must be depended upon as the real protector in case of breakage, regardless of the type of flanges employed, and can never be replaced by the flange as a complete safety device.

The standard type of flange illustrated on this page is known as a relieved flange. This flange grips the wheel only along its outer edge and by means of compressible washers permits of a uniform distribution of the pressure.



# GRITS and GRINDS

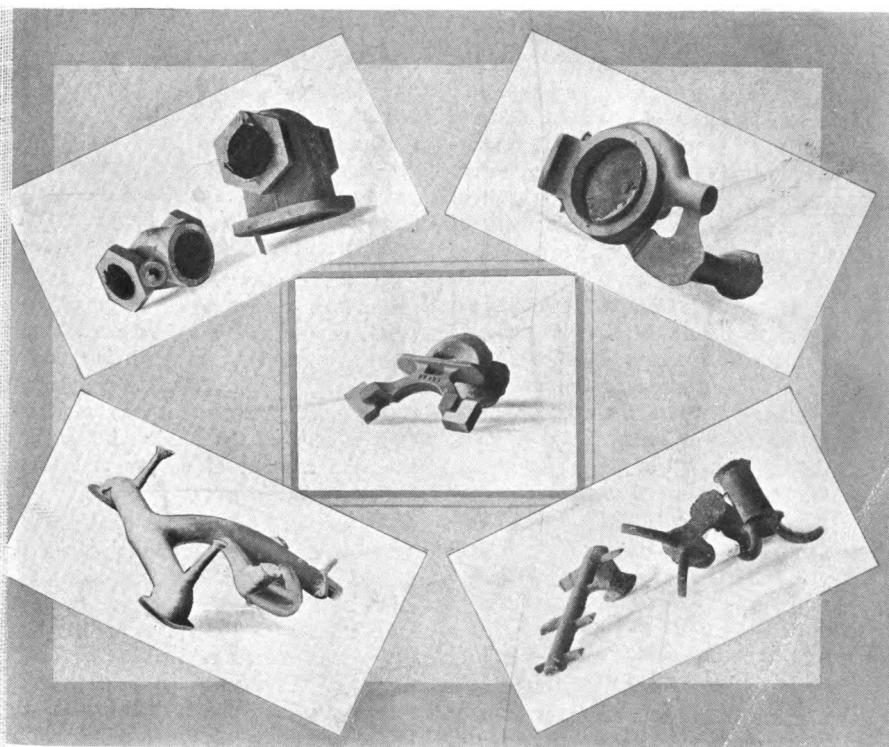
A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASS.

12

MARCH

1912

**THIS ISSUE CONTAINS AN ARTICLE ON GRINDING BRASS,  
BRONZE, ALUMINUM AND OTHER ALLOYS,**



**Samples of Brass and Bronze used in Conducting a Test to Determine the Best  
Grinding Wheel for Grinding these Alloys. Results of Test  
Given on Pages 2 and 3.**



# GRITS AND GRINDS

Vol. III

March, 1912

No. 11

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## Grinding Brass, Bronze, Aluminum and Other Alloys

**Tests Show That the Alloying of Zinc, Tin, Lead, Iron and Manganese to Nickel and Copper Makes Very Little Difference in Their Action on a Grinding Wheel—Crystolon The Most Successful Abrasive on These Alloys—Grains and Grades That are the Most Successful—The One Best Wheel for Snagging of Brasses and Bronzes.**

To develop a wheel that will successfully grind brass, bronze, aluminum and other alloys is one of the most difficult problems that grinding wheel manufacturers have endeavored to solve. Greater success has been obtained in grinding these since the development of modern electric furnace abrasive materials.

The information contained in this article is based on facts brought out in a paper read before Norton Company's 1912 Sales Conference by George W. Thomson, the company's representative in a territory where there are a great many foundries and manufacturers using these alloys.

Mr. Thomson supplemented his paper with samples of castings of the various alloys which samples had been given a thorough test in Norton Company's Department of Tests for the purpose of deciding on a grain and grade of wheel, and the kind of abrasive material that would grind them most efficiently.

### GRINDING BRASSES AND BRONZES

Brass and bronze were forerunners of all casting alloys. It is now necessary, however, to distinguish between numerous kinds of brass of high and low zinc content, red and yellow, bronze, naval brass,

malleable brass, aluminum brass and many others. The term "bronze" was formerly employed to indicate an alloy, the only constituents being copper and tin—copper predominating; but in recent years almost every combination of metals possessing strength and toughness may be described as bronzes.

In trade circles, brass is generally understood to mean an alloy of two-thirds copper and one-third zinc, but in everyday foundry practice it is found to contain other metals besides copper and zinc. The copper content may vary from 60% to 88% of the whole mixture; likewise the amount of copper and tin in bronze varies.

While very desirable qualities for mechanical purposes are obtained by the alloying of zinc, tin, lead, iron, manganese and nickel to copper, with but two exceptions the resulting alloys show very little difference in their action on a grinding wheel of the correct grain and grade. The exceptions are nickel bronze and bell metal—two of the hardest alloys. These can be ground with fair success on the same wheel as the other alloys, but where the quantity of this material coming through will warrant it, it is

recommended that a special wheel of correct grain and grade be used. The content of nickel in nickel bronze and tin in bell metal is sufficient to make them very hard. On nickel bronze a wheel made of Crystolon, grain 24, grade Q gives very good results; and for bell metal, a wheel made of the same material but of a little harder grade. Nos. 24 and 30, grade R wheels are recommended. Comparatively thin wheels are, as a rule, used on bell metal work and the corners are used to quite an extent. The work is, therefore, severe on the grinding wheel.

An experience in grinding brasses and bronzes with two Crystolon wheels will be of interest. A 14 x 2" 24-Q and 14 x 2" 30-P were placed on the same arbor in one of the largest commercial foundries in Connecticut and used ten hours a day every day in the week except Sunday on all shapes and kinds of brasses and bronzes. These wheels were watched very carefully—almost daily—and no noticeable wear of the wheels could be found for several days. They have been running eight months and at this writing measure 12½" diameter. The dresser has not been used on either wheel during this time. The 30-P looks to be working a little the better; the 24-Q not working quite as free and clean.

#### ALUMINUM

This alloy is ductile, malleable and tenacious. In the automobile industry, where light castings are important, alloys containing aluminum and zinc are largely used. In this class of work Crystolon elastic wheels grain 36, grade 4, have been giving very satisfactory service. This wheel has shown best results from tests conducted in our Department of Tests on automobile parts such as lower part of crank case, crank case cover, transmission case, upper and lower float chamber and exhaust pipe. The above wheel was found to remove the metal faster and load the slowest of all wheels tried, and at the same time gave a good surface. Grade 5 elastic process has also shown some good work.

#### NICKEL BRONZE

When experimenting on this alloy, the same wheels were used that were tried on the brass, standard bronze and aluminum.

A feature to be noted, on account of its usual absence in connection with grinding brasses and bronzes, was the formation of very dull red sparks which were quite dense just under the point of contact. These sparks became invisible at approximately four inches from point of contact. All wheels heated the work very quickly and felt "hard"; in fact, this bronze appeared much harder than any of the other brasses or bronzes. The wheels all loaded about equally. The 24-Q and 30-P wheels were the best cutting wheels, perhaps, the 30-P doing the better work although both were about equal.

#### GOVERNMENT BRONZE

This alloy also gave off a very dull, red spark, but was not as noticeable as in the case of nickel bronze. The 30-P was the best wheel as it took hold well, did not load half as much as the 24-Q, although used more, nor did it feel as hard as did the 30-Q and 36-P. A characteristic of these wheels was that the alloy loaded the wheels in small spots less than the size of a pin-head.

In regard to the loading of wheels, experiments showed that aluminum loads more than the other alloys referred to in this article; phosphor-bronze next, Standard Foundry bronze and Government bronze about the same, and nickel bronze the least. All wheels tried were—14 x 1½ x 1½" and run at 1,360 R.P.M., or 5,000 surface feet per minute.

A 30-P Crystolon wheel is recommended for the snagging of all kinds of brasses and bronzes in ordinary commercial foundries. This does not apply, of course, to foundries that melt up one kind of metal for a special purpose. In cases of this kind, it would undoubtedly be policy to test out—say 24-P, 24-Q, 30-P and 36-O Crystolon to determine which is best adapted for the work.

## MILTON P. HIGGINS



Milton P. Higgins, President of Norton Company and Norton Grinding Company, died at his home in Worcester on March 8th, 1912, at the age of sixty-nine years. As the promoter and founder of the Norton Company and the President of both Companies since their organization, Mr. Higgins has been closely identified with their history during a period of twenty-eight years.

He was born in Standish, Maine, December 7th, 1842, learned the machinist trade in Manchester, N. H., and worked his way through Dartmouth College, where he graduated in 1868.

He was Superintendent of the Washburn Shops of the Worcester Polytechnic Institute for twenty-eight years, and after his resignation in 1896 was appointed a Trustee of the Institute, so that his services to that Institution extended over a period of forty-three years.

The greatest ambition of his life was to do his part toward solving the great problem of training boys for useful work in life, and he is known as the originator and father of Worcester's Independent Trade School and a pioneer and active worker in industrial education in the United States.

His wisdom and experience in business enterprises and his unusual talents, particularly in the line of mechanical engineering and invention, have been freely given to the building up of the several business enterprises in which he was interested. He opened larger opportunities to young men to lead useful and honorable lives. He believed in the independence, dignity and honor of the calling of a skilled artisan. One of the expressions of his belief is contained in the following:

### THE PHILOSOPHY OF LEARNING A TRADE

"To make a good living; to have a happy family; to make preparation for hard times; to wear overalls in the shop with the same dignity as good clothes are worn on Sunday; to be confident you are laying a sure foundation for any future success; to feel that you are master of your work, and that you share the creative spirit: this is the wholesome philosophy of learning a trade."

Milton P. Higgins.

Other industries in which Mr. Higgins was interested are: Worcester Pressed Steel Company, as President; The Manchester Supply Company, Manchester, N. H., as President; The Sanford Riley Stoker Company, Ltd., Providence, R. I. He was a director of the Mechanics National Bank of Worcester, former Vice-President of the American Society of Mechanical Engineers and a charter member of the Society for the Promotion of Industrial Education.

## GEORGE A. STONE



George A. Stone, for nearly ten years connected with the interests of our Chicago Store, the latter portion of the time as manager, died at his home in Birchwood, Chicago, Feb. 14th, 1912, and was buried with Masonic honors at Rose Hill Cemetery on Feb. 17th.

After his education at King Grammar School, Night School and Business College he started with Norton Emery Wheel Co. as bookkeeper in the Chicago Office, September 16th, 1902, and assumed the management of the Norton Companys, store in May, 1905. Never was a man more faithful and loyal to the interests of those whom he represented or more optimistic and enthusiastic in anything which he undertook whether in the line of work or recreation. He was exceptionally popular in his large circle of social and business friends, and

suitable words cannot be found to express the great loss which has come to us all.

## To Facilitate Quick Deliveries

**One Million Wheels in Stock—Three Thousand Combinations of Grains,  
Grades and Sizes—Sixteen Thousand Square Feet of Floor Space  
Required—Forty Thousand Running Feet of Rack Room—  
Time Required to Manufacture Wheels—Advantage  
to Customer of Large Stock.**

One of the most interesting departments in the Norton plant is the Stock Room. The visitor seldom fully realizes just what this large stock room means to the users of Norton Grinding Wheels, and the Norton customer doubtless does not fully realize its value to him.

Over 1,000,000 wheels are carried in stock here. There are over 3,000 grains, grades and sizes of wheels varying from  $\frac{3}{8}$ " to 36" diameter,  $\frac{1}{4}$ " to 8" in thickness, grades G to W and grains from No. 12 to No. 220. Large numbers of what might be termed standard sizes, shapes and grades—that is wheels used on well-known grinding machines such as Brown & Sharpe, Landis, Norton and others and which are used to a large extent, are carried in stock at all times. There are about 350 special shapes of the common grains and grades.

To accommodate the million wheels on hand requires about 16,000 square feet of floor space and 40,000 running feet of rack room. If it were possible to build a pyramid of wheels with one 60" diameter by 6" thick wheel as a base, topping the pile with a  $2\frac{5}{8}$ " diameter by  $\frac{1}{8}$ " thick, the man placing the last one would need a ladder eight miles in length to accomplish the feat.

If a man were to start at one end of the Norton Company's stock room and walk through all the aisles between the racks provided for the storage of wheels, he would cover a distance of  $1\frac{1}{2}$  miles before completing his journey.

The reader's curiosity would naturally cause him to ask why such a stock is necessary. The answer is: to facilitate quick deliveries.

Only experienced users of grinding wheels can fully appreciate just why it is necessary, in order to make prompt

deliveries on a customer's order, to carry in stock the wide variety of grains and grades as carried in the Norton stock rooms. He knows that a slight variation in grain or grade of wheel may make a big difference in the cutting efficiency and durability when used on a certain kind of metal and under certain conditions.

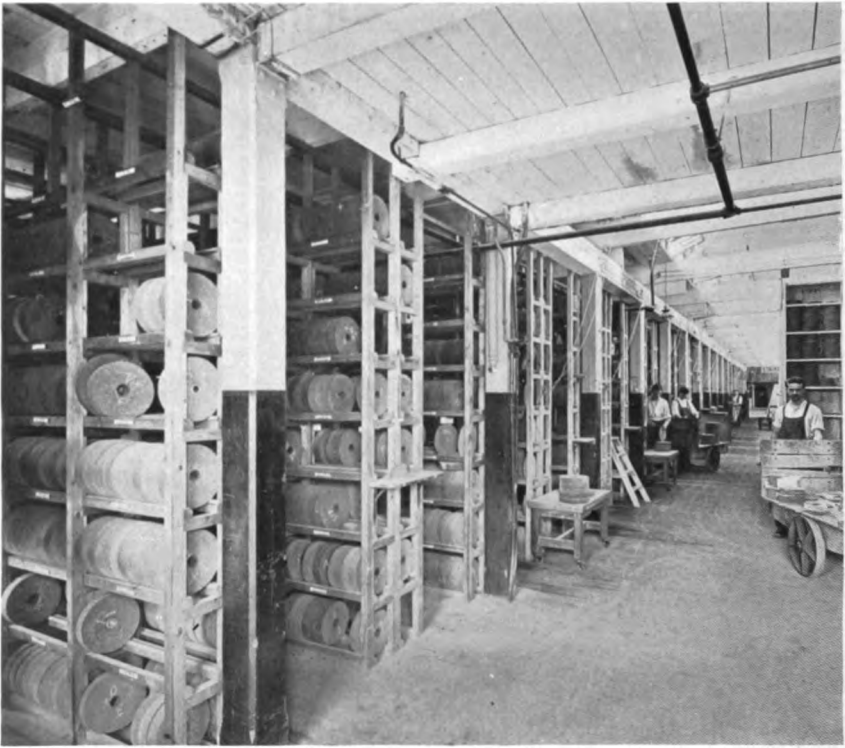
To manufacture a Vitrified wheel requires from three to five weeks, depending on the size, grain and grade. For example, 8" wheels and smaller require three weeks for the various operations of mixing, shaving, burning in the kilns, truing, bushing, facing, testing, inspecting, packing and shipping. Larger wheels, up to 30" diameter, require four weeks. Wheels that are very special in nature, either extra large and thick or especially fine in grain, require even more time than this.

If the reader will take into consideration the time necessary for manufacturing wheels, the great variety of grains, grades, sizes and shapes in use, the necessity of the customer getting the exact grain and grade ordered and the rigid policy of this company to furnish exactly what is ordered and to duplicate previous orders when instructed to do so, he will readily understand why this large stock is necessary.

Each order from the time it is received until it leaves the shipping room passes through thirty-five different operations.

You will readily realize, in view of the above conditions, that the organization and system in use must be dependable in order to minimize errors in manufacturing and shipping.

To handle a stock of grinding wheels of these proportions requires a force of skilled men trained to this special branch of the service.



**View in Norton Company's Stock Room**

The 3,000 different grains, grades and sizes in stock and the "stock orders" going through the works are checked weekly in order to keep on hand a sufficient stock of what might be termed "standard wheels" to meet anticipated requirements. This systematic tabulation of material on hand and in process enables prompt shipments to be made from stock of something like 3,000 different wheels that are largely in demand.

When the wheels are in stock the time required for delivery is from two to four days which time is necessary for the operations of leading holes and to do such other work as is necessary to meet the customers' requirements, and testing, inspecting and packing. This service generally saves the customer from two to four weeks' time.

Fully appreciating the desires and the necessity of grinding wheel users for quick deliveries, the Norton Company have always put forth their best efforts in this direction; but notwithstanding the fact that they have what might be termed a thorough organization and orders go through the plant with the greatest expediency, it is of the utmost importance that customers co-operate in order that they, themselves, may get the best possible service. Customers who are using wheels of a certain size, grain and grade in large quantities find it to their advantage to anticipate their requirements for several months or even a year in advance so that the wheel manufacturers will have an opportunity to keep a sufficient quantity on hand to make shipments as required.

# Abstracts from Current Articles Pertaining to Grinding

## Descriptive Index or Synopsis of Articles Pertaining to the Grinding Industry that Have Appeared in Recent Issues of Technical and Trade Publications

"Re-cutting Milling Cutters without Annealing." By F. B. Jacobs. A method of sharpening ordinary milling cutters using a No. 3 Brown & Sharpe Cutter Grinder. Two 30-tooth "Novo" steel cutters  $3\frac{5}{16} \times 1\frac{1}{2}$ " were gashed, re-cut and backed off in  $2\frac{1}{2}$  hours. Machinery—Dec. 1911, page 258.

Grinding Taps. Three illustrations, in article on "Special Tap Making Machinery," show machine set up for grinding hobs and fluting cutters; guards on machines for polishing shanks and for polishing out flutes. American Machinist—Dec. 7th, 1911, pages 1075-76.

Hardinge Universal Grinder. Hardinge Bros., Chicago, Ill., have recently brought out an addition to the line of precision tools. This machine is designed to do all kinds of internal and external grinding up to 7 inches diameter and 18 inches long, being especially adapted to grinding of cutters, reamers, end-mills, saws and other tool-room work. A cut shows the arrangement and various attachments which go with the machine. American Machinery—Dec. 1911, page 309. Machinist—Dec. 7th, 1911, page 1093.

"Grinding a Ball on the End of a Shaft," by W. Andrews. Illustration of attachment for making a ball upon the end of a shank. American Machinist—Dec. 21, 1911, page 1175.

Wheel Guards for Grinders. Illustration showing line of wheel guards made by J. G. Blount Co., Everett, Mass., for use on dry grinders—adjustable to allow for wear of wheels—made in seven sizes. American Machinist—Jan. 4, 1912, page 38.

Universal Grinder. The Modern Tool Co., Erie, Pa., have brought out a new line of Universal Grinders for general tool room work and light manufacturing.

American Machinist—Jan. 4, 1912, page 39.

"Limit Gage for Grinding Ball Race Cones." By G. W. Linn. Showing how an inexpensive, accurate and durable gage may be made for grinding the radius of ball race cones. American Machinist—Dec. 14, 1911, page 1127.

"The Grinder in the Shop." By F. P. Terry. One method of comparing work of various grinding wheels in a machine shop. American Machinist—Dec. 14, 1911, pages 1127-28.

Motor Driven Disk Grinder. The Gardner Machine Co., Beloit, Wis., has equipped its No. 17 Patternmakers' Disk Grinder with a new motor drive. Features are elimination of end play in spindle, positive gear drive, handy controller for starting and stopping machine and a dust box in base of machine for shops without a dust system. Iron Age—Dec. 14, 1911, page 1316.

Scale Beam Tools and Machine. Figure 3 of this article shows the arrangement of jig and fixtures for grinding the sides of the scale beams. American Machinist—Dec. 28, 1911, page 1216.

"Grinding a Hub Clutch Gage." G. W. Linn elucidates upon a method of making and grinding these gages which are frequently used in automobile factories. American Machinist—Dec. 28, 1911, page 1226.

"Holding Work for Grinding." Three methods used for special shapes pieces in Stevens-Duryea factory. Machinery—March 1912, page 547.

"Efficiency in Cylindrical Grinding" by F. B. Jacobs. States and discusses the causes for low efficiency on the average cylindrical grinder and gives methods of overcoming same. Machinery—March 1912, page 504-506.



We are indebted to Simonds Mfg. Co., Portland, Ore., for the above picture. It is a view of the interior of their store showing display case of grinding wheels and grinding wheel racks containing 3,000 wheels used exclusively for saw sharpening.

This company's branches at Portland, Seattle and San Francisco have had the agency for Norton Grinding Wheels on the Pacific Coast for a number of years. Through their enterprising and aggressive

methods, backed by Norton quality, they have succeeded in making the Norton wheel by far the most popular for saw sharpening in the Pacific Coast territory and are now enjoying a constantly increasing grinding wheel business.

This is but one of the several examples where Norton agencies have succeeded in building up a desirable grinding wheel business by aggressively demonstrating the efficiency of the Norton products.

**Besly Ring Wheel Grinder.** A new, heavy ring wheel grinder equipped with geared lever-feed table. Made by Chas. H. Besly & Co., Chicago, Ill. *Machinery*-March 1912, page 570.

**A cam Grinding Fixture** by Charles K. Tripp. A cam grinding fixture applied to Norton Plain Grinding Machine. *Machinery*-March 1912, page 553.

**Universal Emery Wheel Guard.** Grinding wheel guard that can be applied to any bench machine. Made by Universal Stamping Co., Buffalo, N. Y. *Machinery*-March 1912, page 560.

**"External Grinding Attachment for Bench Lathes."** Article with cuts illustrating two types of external grinding attachments for bench lathes. Attachment carries wheel 4 x 1/2" and is manufactured by the Remington Tool & Machine Co., Boston, Mass. *Iron Trade Review*-March 7, page

**"Disc Grinding in the Pattern Shop."** Use of the Gardner Machine Co.'s Disc Grinder in the pattern shop. *Canadian Machinery*-January 1912.

**"Grinding a Cut-off Tool."** Notes on an efficient way of grinding a cut-off tool. *Canadian Machinery*-January 1912.

# GRITS and GRINDS

A Bulletin on Grinding and Grinding Wheels  
NORTON COMPANY and NORTON GRINDING COMPANY  
WORCESTER, MASS.

1912

APRIL

1912

**THIS ISSUE IS DEVOTED TO BALANCING  
GRINDING WHEELS.**



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## Balancing Grinding Wheels

By H. W. H. Beth

**Impossibility of Casting or Moulding Any Body so that it is in Perfect Balance—  
Standing and Running Balance—Symptoms of Revolving Bodies out  
of Balance—Testing Wheels for Balance—Methods of Balancing—  
Re-balancing—Criticisms of Methods Employed.**

The term "balancing" generally implies two meanings:

a—Testing for balance.

b—Putting wheels in balance.

These two operations I will explain in detail further on in this article.

It is well known to the mechanic that it is practically impossible to make any part of a machine in perfect balance without resorting to "balancing."

If we take a shaft or spindle perfectly ground to a part of a thousandth of an inch and put it on the balancing ways or balancing machine, we generally find that it is out of balance.

The reason for this is that with our present methods employed we cannot make a body of uniform and homogeneous structure. The unit weight of the material in different parts of the body is not alike, due to various reasons.

The physical and chemical composition of the metal the spindle was made from is not uniform, due to imperfect mixing of raw materials, and other conditions. The ingot was not evenly heated, or it cooled unevenly when passing through the rolls. Uneven pressure of the rolls on different parts of the bar, and many other reasons, account for it being out of balance.

There is no solid material known which is of such uniformity that the unit weight in all its parts is alike.

If we keep in mind the practical impossibility to obtain a uniform body from such refined materials as the metals are in comparison with the crude substances which we employ for the manufacture of wheels, the difficulties which we encounter in trying to make perfectly balanced grinding wheels can be easily understood. Looking over the list of raw materials used in the manufacture of our grinding wheels—Abrasives (Alundum and Crystolon) Bonds (Clays, Silicate of Soda, Shellac, Rubber, etc.)—we find they vary considerably in their physical properties. The variation in specific gravity of abrasives and bonds and their inequality in size and shape make a uniform mixture not only physically impossible but give the constituents a tendency to constantly separate during the mixing and pouring operation.

With moulded, pressed and tamped wheels the difficulty in distributing the material evenly in the moulds, or in evenly tamping and pressing the wheels, increases the tendency toward uneven structure.

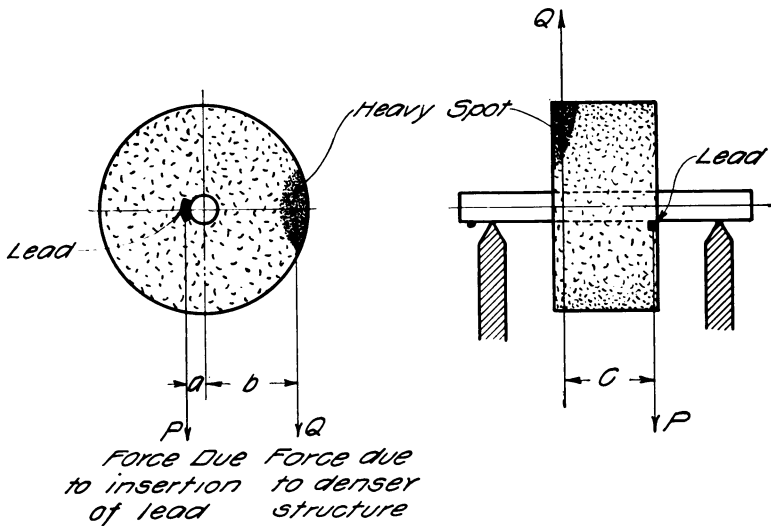


Figure 1.

It should be clear that it is practically impossible to make wheels that are in perfect balance, but I desire to say at this point that we are constantly working on this problem, and while we have not yet solved it, we hope during the coming year to show much progress in this work.

Let us now consider how far we have succeeded in this respect. Taking for instance a 24" x 2" wheel, we will assume that it is 3 ounces out of balance. By this we mean, if we place a 3 ounce weight at the circumference of the wheel opposite the heavy spot, it would be in balance. Three ounces we consider the limit for a wheel (excepting wheels for cylindrical grinding, which should be perfectly balanced) of this size and very few wheels are out as much as this.

This wheel would weigh about 75 lbs., or 1,200 ozs. If we now assume that the heavier half of the wheel would be denser in structure, this would weigh 7.2 oz. more than the lighter one, or expressed in percentage it would weigh 1.2% more. This is a very small amount, and bearing in mind that most wheels come better than this, we must say that we are not very far from attainable perfection in

regard to even structure and balance of wheels.

### Standing and Running Balance

We pronounce a wheel in standing balance if, when placed with its arbor on balancing ways, it will be at rest in any position. But a wheel in standing balance is not always in running balance. In order to make this clear we will try to explain the difference between standing and running balance.

Figure 1 shows a wheel on balancing ways. In standing balance only the forces due to gravity come into action. P and Q are the forces, P is due to the lead inserted to counter-balance the heavy spot, due to denser structure on the opposite side of the wheel, which exerts the force Q. This wheel is in perfect standing balance because the equation of momentum " $P \times a$  equals  $Q \times b$ " is complied with.

But this wheel is not in running balance. If we look at the side view, we find that the heavy spot is on one side and the lead is inserted in the other side of the wheel.

If this wheel is now revolved the centrifugal force comes into action. The

action of the centrifugal force can be easily understood by revolving a weight at the end of a string, the hand holding the other end of the string being the center of the circle. The revolving weight will create a force which is at right angles to the string tending toward making the weight leave its circular path at a tangent, which action, however, is restrained by the string setting up a radial force, the intensity of which is in direct proportion to the weight of the body and to the square of the velocity with which this body moves. Therefore, with twice as many revolutions the centrifugal force is quadrupled.

Returning now to the side view of the wheel sketch in figure 1, we find that the two centrifugal forces set up by the heavy spot and the lead in the revolving wheel act in opposite directions and have the dimension  $C$  as a lever. These

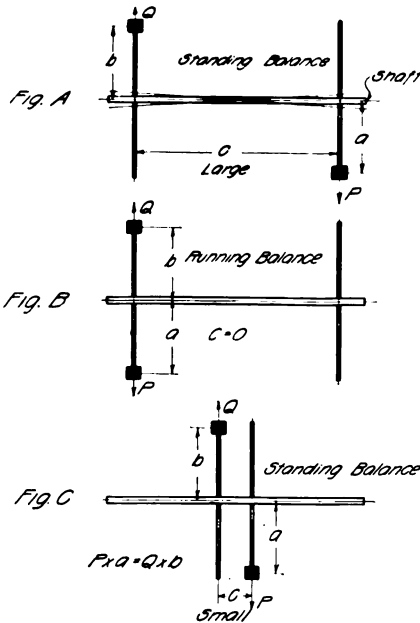


Figure 2.

two forces act at right angles to the center line of the spindle in an opposite direction and at different points; therefore, the wheel cannot be in running balance.

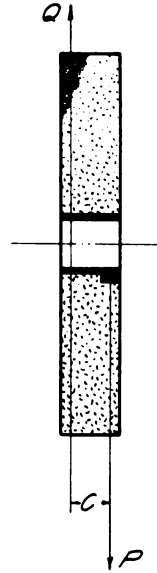


Figure 3.

The balancing machine illustrates this beautifully.

Figure 2 shows a shaft with weights placed on radial arms in three different positions. In each case the shaft is in standing balance.

If we place the shaft as shown in figure A on the balancing machine and revolve it, we find that both ends run "out," due to reasons above explained. Therefore, the shaft is in standing but not in running balance.

If we would revolve the shaft as shown in B we would find that it would run true. The reason for this: the two centrifugal forces working in opposite directions acting upon the same point of the shaft, have no lever to work upon and are, therefore, in equilibrium. The shaft is in standing and running balance.

If we have now shown that a body in standing balance is not always in running balance, why do we not adopt the balancing machine for balancing wheels?

Most grinding wheels have the shape of a disk and the thickness is small as compared with the diameter. If we refer again to A, Figure 2, we find that this

shaft ran "out," while that in B was in running balance. The reason for this was said to be that in the first case the centrifugal forces had a lever to act upon while in the second they had none, in fact they were in equilibrium. Therefore, we can say that the larger the distance is between the points the forces are acting upon, the more they are able to put the shaft out of balance. Fortunately, with wheels, this lever is only small on account of the thickness being small and the action of the centrifugal force in regard to running balance, provided the wheel is in standing balance, can be disregarded. C in Figure 2 shows a shaft where the distance between the two centrifugal forces due to the weights is only small, there-

It is different with wheels where the thickness is considerable as is the case with skin wheels, wide cup wheels and high cylinders.

Figure 4 shows these conditions. If the heavy spot is on one side and the lead is inserted at the opposite side, this would set up a momentum which would throw the wheel considerably out of running balance. Therefore, the use of a running balance machine is to be recommended if it would be important to have this kind of wheel in running balance.

### Ordinary Symptoms of Revolving Bodies out of Balance

We have seen on the balancing machine what happens when we revolve a shaft

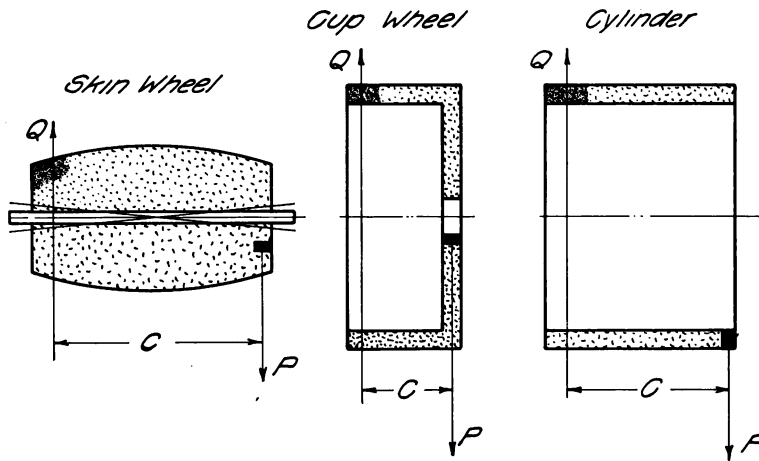


Figure 4.

fore the momentum, which is trying to throw the shaft out of its position, is small. If we revolve this shaft on the balancing machine, we would see that it is only a trifle out of running balance.

Figure 3 shows this condition in a straight wheel in its most unfavorable form. The heavy spot is on one side while the lead inserted for the purpose of balancing the wheel is on the other side. However, the distance C is only small, therefore, the wheel would be very little out of running balance.

which is not in running balance. We have heard that the centrifugal force is in direct proportion to the weight of the revolving body and to the square of the velocity. In the case of the 24" x 2" wheel with 3 oz. out of balance on the face or rim the centrifugal force would be about 500 lbs., a force large enough to impart vibration to a lightly built grinding machine, or in case the bearings are loose, to vibrate the shaft within the bearings, producing chatter marks on the work. Grinding machines cannot be built heavy

enough to eliminate the vibration produced by wheels out of balance, therefore, the only remedy is to balance the wheel.

### Examples of Revolving Bodies that are Balanced

It is a consolation to the maker of grinding wheels that there are other revolving bodies besides grinding wheels which must be balanced if they are to run true and without vibration. All fast revolving machine parts as spindles, flanges and pulleys of grinding machines, turbine wheels and spindles, armatures of dynamos and motors, fans and exhausters, crankshafts, centrifugal separators, fly wheels, centrifugal pump-wheels, spindles of wood-working machinery and many others must be balanced.

### Testing Wheels for Balance

At the present time the maker of grinding wheels is only testing and correcting wheels for standing balance.

A good-fitting arbor, the ends of which have been turned down to insure greater accuracy, is inserted in the hole and the wheel thus placed on the balancing ways. The ways are made of hardened steel, the surfaces whereon the arbor is resting are made narrow to obtain better accuracy. The wheel is allowed to swing back and forth. The amplitude of motion is then chalked and the midway point marked. The heavy spot is then turned to the left and a spring weight fastened at the chalk mark and so much weight is added until the wheel is at rest and therefore in standing balance. To check the result the heavy spot is turned to the right and the weight placed on the left.

### Putting Wheels in Balance

To put wheels in balance two methods are used:

1. Inserting lead.
2. Balancing flanges.

The maker of wheels employs only the first one.

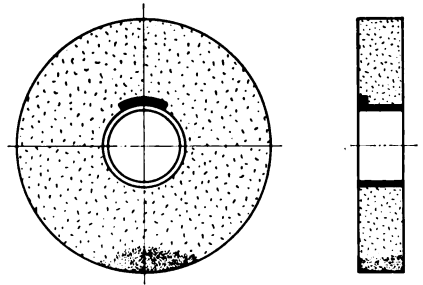


Figure 5

**INSERTING LEAD.** Straight wheels are put in balance by inserting lead near the lead bushing. The amount of lead that has to be inserted for different amounts out of balance can be closely figured out and arranged in a table. We have such a table in use in our shop. To take up the lead, a part of the wheel adjoining the bushing opposite the heavy spot is chiselled out and lead is poured into the cavity thus formed. See Figure 5. Any protruding lead is cut off and the wheel is placed back on to the balancing ways to see whether it is in standing balance. If not enough lead has been inserted more of the wheel has to be cut out and more lead poured in. In the other instance some of the lead has to be removed.

It is better to insert too little than too much lead as when the heavy spot wears down the wheel will come in better balance.

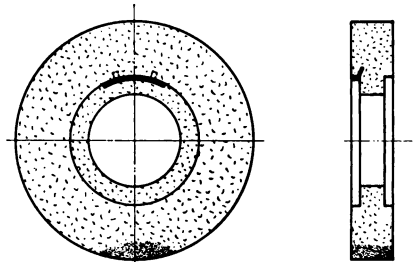


Figure 6.

**COUNTERSUNK WHEELS** are put in balance by inserting lead in the countersink. To take up this lead the diameter of the countersink is generally enlarged or sufficient space is allowed outside the

flanges. To hold this lead in place small round holes are cut in an inclined direction in the wheel. See Figure 6.

The lead inserted for the purpose of balancing is stamped "balance" with a steel stamp. Users of wheels sometimes do not know for what purpose this lead has been put in; in fact, when the writer was recently in Chicago, the foreman of a grinding room said that some of the wheels had pieces broken out near the hole which were filled in with lead. The writer explained to him that this was purposely chiselled out to balance the wheels.

**BALANCING FLANGES.** The Landis Tool Co. has placed on the market flanges with movable weights for the purpose of balancing. Figure 7 shows a sketch of such balancing flanges. The weights are placed in a dove-tailed circular groove. They can be put in a fixed position by means of set screws. The balancing is done by placing the weights opposite the heavy spot of a wheel. To adjust the weights for different amounts out of balance they are either moved away or towards each other. Placing the weights exactly opposite each other will put the flanges in balance.

**RE-BALANCING.** When the heavy spot in the wheel is wearing off with the decreasing diameter of the wheel it becomes necessary to re-balance the wheel. This is done by drilling holes in the lead and thus removing some of the counter weight. Wheels balanced with balancing flanges are re-balanced by moving the weights farther apart.

### Objections and General Criticisms to the Methods Used in Balancing Wheels

Unfortunately, there is at present no method of balancing wheels that is not open to criticism.

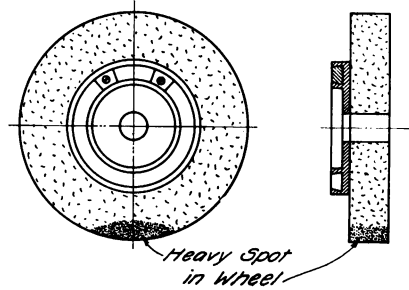


Figure 7.

Inserting lead reduces the strength of the wheel. Another objection is that the wheel becomes out of balance again on the side where the lead has been inserted when the wheel wears down and has to be re-balanced.

The main objection to balancing flanges is that each wheel must have a balancing flange, as otherwise it would be necessary to balance a wheel each time it is put in use. However, it seems as if this objection can be overcome by marking the position of the balancing weights on the wheel when it is put out of use and locate them in the same position, when it is put in use again.

**When every user of grinding wheels fully realizes that it is impossible to manufacture wheels in perfect balance and informs himself regarding the best methods of testing wheels for putting them into balance, there will be fewer troubles from this cause and more successful results will be attained.**

In conclusion, I hope I have called the attention of the users of grinding wheels to the real truths concerning a chronic trouble which will always be with us as long as we use grinding wheels.

The mechanic and engineer must realize that grinding wheels will at times be out of balance and that the methods of putting them in balance should be common knowledge as much as putting into balance any other cylindrical revolving body.

# Abstracts from Current Articles Pertaining to Grinding

## Descriptive Index or Synopsis of Articles Pertaining to the Grinding Industry that Have Appeared in Recent Issues of Technical and Trade Publications

The March 1912 edition of "Castings" has given, under the head "Grinding Wheels and Machinery," a few general suggestions for users of grinding wheels. Page 195.

"Making Worm Gears in England," by I. W. Chubb. Article with several cuts which show the methods used in grinding worm gears for the motor trade. *American Machinist*—April 11, 1912—pages 582-583.

"Grinding and Corrugating Rolls," by F. A. Stanley. Methods of handling chilled iron rolls in an Omaha shop where the surfaces are ground true by rotating the work upon its own journals. *American Machinist*—April 11, 1912—pages 589-590.

Brown and Sharpe Internal Grinding Machine manufactured by Brown & Sharpe Mfg. Co., Providence, R. I. This company has placed on the market an internal grinder for general internal grinding operations with special attention to the grinding of hardened steel gears, cutters, collets, bushings and similar work. This machine is fully described in *Machinery*, April 1912—pages 644-645. *American Machinist*, April 4, 1912—page 839. *American Machinist*, April 11, 1912—pages 603-604.

Vertical Spindle Disk Grinder. The Gardner Machine Co., of Beloit, Wis., have brought out a new vertical spindle disk grinder. The disk is 53 inches in diameter, motor drive and runs at 500 R. P. M. Complete machine weighs 4,500 lbs. *American Machinist*, April 4, 1912—page 564.

"Special Work on Double Spindle Grinder." Article with cuts illustrating the process of automatically burring and sizing bicycle-chain blocks by means of a double-spindle Besly grinder. *American*

*Machinist*, Mar. 21, 1912—pages 475-476.

An improved Single-Stroke Surface Grinder. The Walker Grinder Co., Worcester, Mass., have recently put on the market an improved design of the above surface grinder which is especially adapted for the rapid grinding of small flat surfaces. *American Machinist*, Mar. 21, 1912—page 480. *Machinery*, April, 1912—pages 645-646.

"Oilstone Attachment for Tool Grinder," by F. J. Hohnhorst. A diagram and short exposition explaining how to construct an oilstone attachment to secure a smooth, keen edge on reamers, rosebits, etc., with special attention to stoning spiral reamers. *American Machinist*, Mar. 21, 1912—page 482.

"Grinding Wheel Truing Device," by J. B. Good. A discussion of various methods for truing grinding wheels on plain and surface grinding machines. *American Machinist* (European edition), March 23, 1912—page 51E.

"Grinding Chilled Cast Iron Rolls," by Walter G. Groocock. An analysis of fast grinding of cast iron rolls showing that heavy cuts are costly and not necessary for quick, economical production. *American Machinist*, Mar. 28, 1912—pages 513-514.

New Grinder Countershaft. The Rivett Lathe & Mfg. Co., Brighton, Mass., are building a new type grinder countershaft. A cut with description is shown in *American Machinist*, April 4, 1912—page 563.

The saw gummer gets its name from the fact that it is used to dress down that part of the saw around the base of the teeth that some facetious man might designate as gums. It's an odd derivation, but there are many other things in this world that can give it odds and beat it.

—SIMONDS GUIDE FOR MILLMEN.













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